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THE

BRITISH ENCYCLOPAEDIA
OF MEDICAL PRACTICE

INCLUDING

MEDICINE SURGERY
OBSTETRICS GYNAECOLOGY
AND OTHER SPECIAL SUBJECTS

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VOLUME TEN

POISONS LEGISLATION *TO* ROSACEA

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POISONS LEGISLATION: MEDICAL ASPECTS

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   - (10) Hospitals and Other Institutions – – 10

Reference may also be made to the following title:

TOXICOLOGY

1.–DEFINITIONS

Poison
Dangerous drug

1281.] For the purposes of the Pharmacy and Poisons Acts, 'poison' means a poison included in the Poisons List. There is no statutory definition of 'dangerous drug', but the term is commonly used to mean a substance or preparation to which the Dangerous Drugs Acts, 1920 to 1932, apply.

2.–POISONS

(1)—Legislation

Poisons are controlled by the Pharmacy and Poisons Act, 1933, and various orders and rules made under it.

Poisons Board

The Home Secretary is the authority ultimately responsible for the administration of the provisions of the Pharmacy and Poisons Act, 1933, relating to poisons. To advise him there is a Poisons Board comprising representatives of Government Departments, of the Pharmaceutical Society of Great Britain, and of medicine and chemistry. The Poisons Board prepare and submit to the Home Secretary for his approval the Poisons List and from time to time propose amendments. Statutory rules controlling *inter alia* sale, storage, transport, and labelling of poisons, the manufacture, compounding, and dispensing of poisons, and for other purposes are made by the Home Secretary after consultation with or on the recommendation of the Poisons Board.

In *Poisons No. III (Practitioners and Hospitals) Memorandum, 1936*, published by H.M. Stationery Office, the Poisons List, as in force at the date of publication, is included, together with a list of substances containing poisons which are exempted from the provisions of the Act and Rules.

Poisons List

A substance included in the Poisons List is subject to control not only when undiluted but also when diluted or contained in a preparation, unless in an article specifically exempted by inclusion in the Third Schedule to the Poisons Rules. Salts of alkaloids, whether simple or complex, are included with the parent alkaloid, as are synthetic reproductions of natural substances. So-called 'crude drugs', such as digitalis leaves and dried thyroid, are included by reason of their active principles being named in the list.

Poisons Rules and Schedules

The Poisons Rules, 1935, apply provisions of various degrees of stringency to various groups of substances containing poisons. The groups most important to medical practitioners are those included in the First and Fourth Schedules to the Poisons Rules, 1935. The Second Schedule contains a list of poisons exempted from the labelling provisions when sold or supplied 'within the trade'. The Third Schedule is a list of articles exempted entirely from the provisions of the Act and the Rules. The Fifth Schedule sets out the form, e.g. sheep-dips, agricultural and horticultural insecticides, and preparations for the destruction of rats and mice, to which certain poisons are restricted when sold by persons listed as sellers of poisons by local authorities. The Sixth Schedule provides special methods of declaring the proportion of the poison present for certain poisons. The Seventh Schedule prescribes cautionary words to take the place of the word 'Poison' on the labels of certain substances. The Eighth Schedule is a list of poisons to which certain provisions relating to transport apply. The Ninth Schedule is the form of application for a name to be placed on the list kept by a local authority, and the Tenth Schedule is the form of the list. The Eleventh Schedule contains the form of certificate for the purchase of a poison, and the Twelfth Schedule contains the form of entry to be made in the Poisons Register.

(2)—First Schedule Substances

The substances included in the First Schedule to the Poisons Rules are the more potent poisons and preparations containing them, in some cases in any dilution and in other cases above a specified dilution. Special restrictions are placed on the sale of these substances to the public, but the restrictions affect medical practitioners only to the extent mentioned below in subsection (4) Supplies to Medical Practitioners.

(3)—Fourth Schedule Substances

The Fourth Schedule includes amidopyrine and its salts, barbituric acid and its derivatives, dinitrophenols, phenylcinchoninic acid (cinchophen) and its derivatives, and sulphonal and alkyl sulphonals. The provisions controlling these substances are given in detail in subsection (7) Special Restrictions on Sale of Fourth Schedule Substances.

(4)—Supplies to Medical Practitioners

A medical practitioner may obtain poisons 'for the purpose of his profession' from any 'authorized seller of poisons', i.e. any retail chemist, and from any wholesale or manufacturing druggist. Substances included in the First Schedule can be obtained only if (i) the practitioner is known by the seller to be a person to whom the poison may properly be sold, and (ii) the practitioner attends at the premises of the seller and signs the Poisons Register or sends an order 'in writing signed by the purchaser stating his name and address . . . profession, the name and quantity of the article to be purchased and the purpose for which it is required'. The seller must be reasonably satisfied that the signature is genuine and that the purchaser practises the profession stated in the order. If the article is sent by post, it must be sent by registered post. These formalities apply equally to the supply of commercial samples of First Schedule substances.

Poisons included in First Schedule

Poisons Register

Written order

In an emergency a medical practitioner may obtain First Schedule substances for his professional use if he gives an undertaking to the supplier that he will furnish a written order within the next twenty-four hours. The supplier must be satisfied that the practitioner does in fact

Emergency

require the poisons urgently for professional use, and that he is prevented from furnishing the order or attending and signing the Poisons Register by reason of some emergency. A medical practitioner who has been supplied with poisons in response to such an undertaking and who fails to furnish the order is guilty of an offence under the Act.

Poisons not included in First Schedule

There is not any statutory provision regulating the supply to practitioners of poisons which are not included in the First Schedule.

(5)—Supplies by Medical Practitioners to Patients

A medical practitioner is permitted to supply medicines containing poisons for the purposes of medical treatment if he complies with the following provisions:

Labels

(i) The medicine must be labelled with the name and address of the practitioner. If the medicine is an embrocation, liniment, lotion, liquid antiseptic, liquid disinfectant, or other liquid medicine for external application, the container must be labelled with the name of the article, e.g. 'The Liniment', 'The Lotion', and 'For External Use Only'.

Poisons included in First Schedule

(ii) If the medicine is a First Schedule substance, there must be entered in 'a book which is used regularly for the purpose' but which need not be used exclusively for it, e.g. the practitioner's day-book: (*a*) the date, (*b*) the ingredients and the quantity, and (*c*) the name of the patient. The entry must be made on the day of supply or, if that is not reasonably practicable, on the following day.

Dispensed

Administered

The following passage occurs in the Home Office Memorandum already referred to: 'It is to be noted that these requirements apply only in the case of medicines dispensed by a dispensing doctor . . .; they do not apply to a medicine which is administered by a practitioner personally to his patient, e.g. a tablet, given to or left with a patient by his doctor when attending him personally.'

(6)—Storage

The only requirement regarding the storage of poisons which concerns medical practitioners is that the container of the poison must be impervious to the poison and sufficiently stout to prevent leakage from the container arising from the ordinary risks of handling.

(7)—Special Restrictions on Sale of Fourth Schedule Substances

Prescription

It is an offence to sell to a member of the public a Fourth Schedule substance, whether diluted or not, except on and in accordance with a prescription given by a medical practitioner, or by a dentist for dental treatment, or by a veterinary surgeon for treatment of animals. The prescription must contain the particulars given in the following skeleton: (i) prescriber's address (except on N.H.I. or local authorities' scripts); (ii) name and address of patient or, on veterinary scripts, of person to whom medicine is to be delivered; (iii) name and definite quantity of poison; (iv) on dental scripts: 'For dental treatment only'; on veterinary scripts: 'For animal treatment only'; (v) directions for repetition, if any; (vi) dose to be taken; (vii) date (written by prescriber);

and (viii) usual signature of prescriber. The body of the prescription may be printed or typewritten, but the date and the signature must be written by the prescriber himself.

Dispensing

These prescriptions may not be dispensed more than once, unless the prescriber has stated thereon that they may be dispensed more than once. If the prescription contains a direction that it may be dispensed a stated number of times or at stated intervals, the person dispensing it must observe this direction. The prescription must be retained by the person dispensing it, unless it is valid for repetition. If a prescription bears no precise indication of the number of times it may be dispensed but has some general direction, such as 'To be repeated as required', the patient may obtain the medicine on the prescription indefinitely.

The Home Office Memorandum points out that 'the question whether a practitioner may properly issue a prescription upon which a drug can be obtained indefinitely is one for the practitioner himself to decide in the light of the circumstances of the case'.

(8)—Medical Practitioners 'Keeping Open Shop'

Inspection

A medical practitioner, unless he has other qualifications permitting him to do so, cannot become 'an authorized seller of poisons'. He can, however, keep a shop for the sale of drugs which are not poisons and from that shop can supply as a medical practitioner to his patients medicines containing poisons. The shops of medical practitioners may be inspected by the Pharmaceutical Society's inspectors.

Among the miscellaneous provisions of the legislation may be mentioned the following:

Prescription book

(i) The requirement that a dispensing chemist must make a copy in his prescription book of medicines dispensed by him is waived for National Health Insurance prescriptions and for prescriptions issued for a health service of a local authority, provided they are on a form issued by the authority.

Strychnine

(ii) It is unlawful to sell or supply strychnine except as an ingredient in a medicine.

Manufacture of drugs containing poison

(iii) Pharmaceutical preparations containing a poison and manufactured for the purpose of the internal treatment of human ailments must be manufactured by or under the supervision of a registered pharmacist or a Fellow or Associate of the Institute of Chemistry. There are two exemptions: the manufacture under the supervision of a medical practitioner of certain biological products and the manufacture of any preparation by or under the supervision of a person who for a period of three years before the Rules came into operation was continuously engaged in the manufacture of pharmaceutical preparations containing poisons prepared for the internal treatment of human ailments. Such a person must furnish the Registrar of the Pharmaceutical Society with a statement in writing to that effect verified by a statutory declaration.

(9)—Offences

Proceedings for failure to comply with the provisions of the Pharmacy and Poisons Act are taken in England in a court of summary jurisdiction and in Scotland before the sheriff. The penalty for an offence relating to poisons is a fine not exceeding £50 and, for a continuing offence, a further fine not exceeding £10 for every day during the period in which the offence is continued after the day of conviction. The Act provides that in the case of proceedings in connexion with the sale or supply of poisons by an employee it is no defence that the employee acted without the authority of the employer, and any material fact known to the employee shall be deemed to have been known to the employer.

(10)—Hospitals and Other Institutions

Out-patients

There are special provisions in the Poisons Rules for medicines containing poisons for the treatment of human ailments dispensed to out-patients from a hospital, infirmary, or dispensary maintained by any public authority, or out of public funds, or by a charity, or from the dispensary of a Friendly Society approved by the Ministry of Health for the purposes of the National Health Insurance Act, 1936. Such medicines may be supplied only by or on the prescription of a medical practitioner or dentist for the purpose of medical or dental treatment.

Records

If the substance is included in the First Schedule, a record must be kept in the institution in such a way that the name and quantity of the poison, the date of supply, the name and address of the patient, and the name of the physician can readily be traced at any time during a period of two years. This provision does not apply to practitioners' prescriptions under the National Health Insurance Act.

Labels

The container of the medicine must be labelled 'with a designation and address sufficient to identify the hospital . . . from which it was supplied'.

In-patients

Medicines containing a poison from the dispensing or pharmaceutical department of a hospital may be supplied only upon a written order signed by a medical practitioner or a registered dentist or by a sister or a nurse in charge of a ward, theatre, or other section of the institution, except in cases of emergency.

Storage

Certain special labelling and storage requirements for institutions are also prescribed. The arrangements for the storage of poisons must be inspected at regular intervals not exceeding three months by a pharmacist or some other person appointed by the authorities of the institution.

3.—DANGEROUS DRUGS

(1)—Legislation

Dangerous drugs are controlled by the Dangerous Drugs Act, 1920, as amended in 1923, 1925, and 1932, and by the Dangerous Drugs

Regulations, 1937, the Raw Opium etc. Regulations, 1937, and the Methylmorphine and Ethylmorphine Regulations, 1933. All dangerous drugs are included in the Poisons List and are subject to the provisions of the Pharmacy and Poisons Act, 1933, as well as to the provisions of the Dangerous Drugs Acts and Regulations.

(2)—Classification

For the purposes of the statutes and regulations, dangerous drugs are divided into three classes: (i) raw opium, coca leaves, and Indian hemp and all preparations of which such resins form the base; (ii) prepared opium; and (iii) a number of substances including medicinal opium, morphine, cocaine, and heroin.

Prepared opium

Prepared opium is opium prepared for smoking, including dross and any other residue remaining after opium has been smoked. Its import into and export from Great Britain, its manufacture, possession, and sale, and any dealings in it are prohibited.

Raw opium

Cocaine, morphine

The import and export of the drugs in class (i) may take place only under licence and their use is rigidly controlled by the Raw Opium etc. Regulations, 1937. The import and export of drugs in class (iii) is controlled by licence, and the Dangerous Drugs Regulations, 1937, strictly control the manufacture, supply, advertisement, possession, delivery by messengers, prescribing, and marking of packages and bottles of these drugs. The Methylmorphine and Ethylmorphine Regulations, 1933, control transactions in codeine and dionin.

Among the preparations exempted from the Regulations are the following: Dover's powder and mixtures of Dover's powder with grey powder, aspirin, phenacetin, quinine and its salts, and sodium bicarbonate; gall and opium ointment; and the following elixirs and preparations of the British Pharmaceutical Codex: camphorated linctus of diamorphine, elixir of diamorphine and terpin with apomorphine, linctus of diamorphine and thyme, linctus of diamorphine with ipecacuanha, and linctus of diamorphine and squill.

(3)—Authorized Persons

Importation

The general framework of control is that no raw material or manufactured drugs may be imported into Great Britain except under licence. Furthermore substances to which Part I of the Dangerous Drugs Act, 1920, applies, e.g. raw opium, may only be imported at approved ports. A licence to export raw opium is subject to conditions to prevent the infringement of laws of foreign countries prohibiting or restricting its importation into such countries. An additional control of imports into this country is provided by the regulations imposed by foreign governments, which require the foreign exporter to be licensed by his government and the British importer to be licensed by the British Government. The manufacture of dangerous drugs, except by authorized persons and on authorized premises, is forbidden.

Manufactur

Possession of the drugs is restricted to persons authorized under the

Possession
By patient
By practitioner
By retail chemist

Regulations or by a special authority from the Home Office. Those so authorized are: (i) a patient who has obtained a drug or preparation (*a*) from a medical practitioner who dispensed his own prescriptions or (*b*) upon a prescription given by a medical practitioner; a patient receiving a drug or preparation from two practitioners at once is not authorized unless he has disclosed to the second practitioner the fact that he is already obtaining the substances from the first practitioner; (ii) duly qualified medical practitioners; (iii) registered dentists; (iv) registered veterinary surgeons; (v) pharmacists dispensing medicines at a public hospital or other public institution; (vi) persons in charge of a research or teaching laboratory attached to an approved educational institution; (vii) persons duly appointed by a local authority as analysts for the purposes of the Food and Drugs Acts; (viii) persons acting as sampling officers under the Food and Drugs Acts; (ix) persons duly appointed by the Pharmaceutical Society of Great Britain as inspectors under the Pharmacy and Poisons Act; (x) persons engaged on a scheme for testing drugs under the National Health Insurance Acts. These persons are authorized only so far as is necessary for the practice of their respective professions, functions, or employments; their authority extends to the possession and supply of the drugs or preparations, except that a dentist may supply only drugs or preparations which are administered by him, or under his direct supervision and in his presence, to persons receiving treatment from him; and (xi) 'authorized sellers of poisons', i.e. retail chemists, authorized to retail, dispense, or compound drugs or preparations in the ordinary course of their retail business. They are required to keep the drugs or preparations in a locked receptacle which can be opened only by the proprietor or by an assistant who is a pharmacist.

(4)—Withdrawal of Authority

Any authorized person is liable to the withdrawal of his authority by the Home Secretary if he has been convicted of an offence under the Dangerous Drugs Acts or of an offence under the enactments relating to the customs as applied to dangerous drugs, and if the Home Secretary considers that he cannot properly be allowed to remain an authorized person. When the person whose authority is withdrawn is a medical practitioner, a dentist, or a veterinary surgeon, the Home Secretary may direct that it shall no longer be lawful for him to give prescriptions for the purposes of the Regulations.

Tribunal

If the Home Secretary has reason to suspect that a medical practitioner or a dentist is supplying dangerous drugs either for himself or for any other person otherwise than is properly required for medical or dental treatment, he may refer the matter to a tribunal of three medical practitioners, or in the case of a dentist to three dentists, with a legal assessor and, if the tribunal recommends, may withdraw the authority of the practitioner or the dentist without prosecution and conviction.

(5)—Form of Prescription

The following are the essential requirements: (i) patient's name and address (if the prescriber is a veterinary surgeon, the name and address must be those of the person to whom the medicine is to be delivered); (ii) names and quantities of drugs or of B.P., B.P.C., or Drug Tariff preparation containing them; (iii) 'For local dental treatment only' (on dental prescriptions); 'For animal treatment only' (on veterinary prescriptions); date (to be inserted by the prescriber); (iv) prescriber's address (unnecessary on National Health Insurance prescriptions); (v) prescriber's usual signature.

The body of the prescription may be printed or typewritten, but the date and the signature must be written by the prescriber himself. A chemist is not permitted to supply a dangerous drug on a prescription which does not comply with these requirements.

(6)—Repetition of Prescription

If a prescription expressly states that it may, subject to the lapse of a specified interval or of specified intervals, be dispensed a second or a third time, the drug or preparation thereby prescribed may be supplied by the chemist in accordance with these directions but not more than three times in all.

(7)—Keeping of Records

Form of entry

Every person authorized to supply drugs or preparations must keep detailed records both of the drugs and preparations he receives and of the drugs and preparations he supplies. The entries must be in the following form:

RECEIPTS

Date on which supply received	Name | Address of person or firm from whom obtained	Amount obtained	Form in which obtained

SUPPLIES

Date on which the transaction was effected	Name | Address of person or firm supplied	Authority of person or firm supplied to be in possession	Amount supplied	Form in which supplied

The class of drugs and preparations to which the entries relate must be specified at the head of each page in the Register.

Form of keeping entries

These records may be in the same form as the records kept by a chemist, in which event the practitioner will probably use one of the standard dangerous drugs registers published by firms of chemists' printers. Alternatively, the record of supplies may consist of an entry in a day-book of particulars of every dangerous drug supplied by him to any person, with the name and address of that person and the date of the supply, together with an entry in a separate book, kept for that purpose only, of a proper reference to each entry in the day-book which relates to the supply of a dangerous drug, i.e. there must be an index book which will enable dangerous drugs prescriptions in the day-book to be readily traced. The entries in the index must be in chronological order, and the book must be kept in separate parts relating to (i) cocaine and ecgonine and their preparations, (ii) morphine and its preparations, (iii) diacetylmorphine and its preparations, (iv) medicinal opium, (v) extracts or tinctures of cannabis, (vi) eucodal and its preparations, (vii) dicodide and its preparations, and (viii) dilaudid and its preparations. The entries must be made on the day of the supply or, if this is not reasonably practicable, on the day following that day. The books must be kept on the premises to which they relate so as to be at all times available for inspection by any person authorized by the Home Secretary.

'ex book

pection

These entries need be made only when the medicine is dispensed by a medical practitioner who dispenses his own medicine. No entry need be made when a drug or preparation is administered by a medical practitioner or dentist or under his direct supervision and in his presence.

All registers and books must be retained for a period of two years from the date of the last entry.

(8)—Supplies to Medical Practitioners and Dentists

Practitioners may obtain dangerous drugs from retail chemists or from wholesale druggists licensed by the Home Secretary. They may do so by attending at the seller's premises personally and signing his poisons register or by sending an order in writing signed by the practitioner, as for any other substance included in the First Schedule to the Poisons Rules. The order must be signed by the purchaser and must state his name, address, and profession, the name and quantity of the article to be purchased, and the purpose for which it is required.

(9)—Codeine and Ethylmorphine

The Methylmorphine and Ethylmorphine Regulations, 1933, control the supply and possession of these drugs in quantities exceeding one pound avoirdupois and their manufacture. For the purposes of prescribing and dispensing therefore they may be regarded as being free from the requirements which apply to other dangerous drugs.

(10)—Hospitals and Other Institutions

:emptions

The control of dangerous drugs in hospitals and similar institutions is effected by exempting them from the requirements of the Dangerous Drugs Regulations, subject to compliance with the conditions laid down in the Dangerous Drugs (Hospital General Exemption) Order, 1924. The institutions exempted are 'any hospital or infirmary or asylum

. . . supported by any public authority or out of any public funds or by a charity or voluntary subscription' in which the drugs are dispensed by a pharmacist or a medical practitioner. Similar institutions in which the dispensing is not undertaken by a medical practitioner or a pharmacist are, subject to compliance with other conditions, exempted from certain requirements of the Regulations.

Records

Dispensing

Orders for dangerous drugs in institutions of the first class must be signed by one of the medical practitioners attached to the institution or by the dispenser if he is a pharmacist. Records of the drugs must be kept, and medicines containing drugs must be dispensed only for the use of individual patients on the prescription of the medical practitioner in charge of the patient.

Prescriptions

Prescriptions, which may be given on the patient's bed card or case sheet, must be in writing and dated and signed by the practitioner. They must state either the name of the patient or the number of the case. A fresh prescription must be given on each occasion on which a fresh supply of the medicine is required. Prescriptions must be kept for at least two years.

Stock preparations

Stock preparations of the drugs for wards or out-patient departments may be supplied on the written request of the sister in charge. They must be kept by her under lock and key and be used by her only in accordance with the directions of one of the medical practitioners in charge of the patients.

Preparations may be prescribed by reference to any conventional name by which they are known in the hospital.

In institutions of the second class orders to suppliers must be signed by one of the practitioners attending the institution, and the drugs must be received and kept by the matron. The drugs may be used or administered by the matron only in accordance with the directions of the medical practitioners attending the hospital.

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POLIOMYELITIS AND POLIOENCEPHALITIS

SECTIONS 1 AND 6–10

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SECTIONS 2–5

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1.–DEFINITION

(*Synonyms.*—Acute anterior poliomyelitis; Heine-Medin disease; infantile paralysis)

1282.] Poliomyelitis is an infection of the central nervous system by a neurotropic virus which acts primarily and directly upon the nerve-cells, with a special affinity for those of the ventral horns of the cervical and lumbar enlargements of the spinal cord. The interstitial tissues and the leptomeninges are secondarily affected. The virus is an obligatory intracellular parasite which multiplies within the nerve-cell during its brief period of activity. It has been customary in the past to speak of cerebral, cerebellar and brain-stem forms of this malady as polioencephalitis.

2.–AETIOLOGY

Causal agent

Artificial cultivation

The aetiological agent of poliomyelitis, one of the smallest filterable viruses known [12 to 17mμ (Theiler and Bauer); 8 to 12mμ (Elford *et al.*)], is also one of the most strictly neurotropic. It has little or no affinity for any but nervous tissue and has been cultivated outside the body only in tissue-cultures of human embryonic brain (Sabin and Olitsky). Most workers have been unable to confirm Flexner and Noguchi's claims in respect of their 'globoid bodies'. It survives many years in glycerin at temperatures around 0° C. Hitherto it has proved pathogenic only for man, anthropoid apes, and monkeys.

Experimental disease in animals

The virus was first isolated in monkeys by Landsteiner and Popper in 1908. In the following years intensive studies by Flexner and his associates and by many others laid the foundations of precise knowledge of the disease. The experimental malady in the monkey reproduces many of the features of severe infections in man and, whatever the route of inoculation, commonly takes the form of an ascending paralysis fatal through involvement of the vital centres of the medulla. It is transmitted most regularly by intracerebral, intrathecal, or intraneural inoculation, or by multiple intranasal instillations; less regularly by other routes. Poliomyelitis is contagious only in man.

Presence of virus in nervous tissues

In nasopharynx

Absence from blood and cerebrospinal fluid

In more than half the fatal cases during epidemics (less constantly perhaps from sporadic cases) virus is isolated readily from the cord and brain-stem. In monkeys it is present also in the dorsal root and sympathetic ganglia, peripheral nerves (inconstant), hypothalamus, basal ganglia, and cerebellum, but rarely in parts of the cerebral cortex other than the motor areas. Outside the nervous system the only regions in which it is found with any regularity are the tonsils and nasopharyngeal mucosa. In man it has often been demonstrated in these structures in fatal cases and in the nasal washings of living subjects during or prior to the acute stage of the disease. It has occasionally been demonstrated in washings from abortive cases (Paul *et al.*), convalescents (at 17 days and 5 months, Kramer *et al.*), and apparently healthy contacts (Kramer, 1935). It has never been found in the blood or cerebrospinal fluid in man, though occasionally these fluids may be infective at the height of the disease in monkeys.

3.–MORBID ANATOMY

Anterior horns

In cases fatal early in the phase of paralysis the nervous system as a whole is more or less congested. On section, the ventral horns of the spinal cord, and in cases with bulbar involvement parts of the brain-stem, are pinker than normal and beset with haemorrhagic points and streaks representing greatly distended vessels. Often these are ruptured during removal of the cord, or perhaps immediately before death, but haemorrhages of any extent are not seen. In cases fatal after a somewhat longer period the ventral horns may be softer than normal, but in old-standing cases they become shrunken, pale, and sclerotic.

Lymphoid hyperplasia

Submucous haemorrhages in stomach

No constant changes are found in other organs. Generalized lymphoid hyperplasia has been prominent in some epidemics and wanting in others. Since Flexner (1936) has recently cast doubt upon his own finding of virus in affected mesenteric glands, it is improbable that this hyperplasia, when present, is a specific effect of the virus. Submucous haemorrhages in the gastric mucosa were present in 75 per cent of cases during the New York epidemic of 1931 and have been noted during the Australian epidemic of 1937–8.

Microscopical appearances

Microscopically, lesions are most pronounced in the ventral horns of the spinal cord at levels corresponding to paralysed muscle-groups and in the brain-stem. They are probably always present in the posterior horns, spinal ganglia, hypothalamic region, and parts of the basal ganglia, and often in the motor cortex and olfactory bulbs. Small cellular foci occur inconstantly in the peripheral nerves (*septinévrite* of Nicolau, Dimancesco-Nicolau, and Galloway).

Course of the infection

The older accounts of the sequence of changes in the infected nervous system were based on necropsies of fatal cases in man, in most instances inevitably of some duration. With few exceptions the writers believed that virus carried by the blood-stream or cerebrospinal fluid evoked a primary meningitis; the inflammation, spreading inwards to the grey matter along the perivascular sheaths, affected the nerve-cells wholly or in part by impairing their nutrition. In the monkey, an animal in which it is possible to study at all stages a morbid process almost identical with that in man, quite a different impression is obtained (Hurst), and one in conformity with the findings in hyperacute human cases. As in all virus diseases, the primary attack is on the cells susceptible to the action of the virus, in this case the nerve-cells, and the inflammatory and reactive phenomena are secondary; no doubt, after the initial stage, oedema and exudate may contribute, through pressure and impairment of nutrition, to the downfall of the nerve-cells. These undergo degeneration varying in severity with their situation in the nervous system, the particular host infected (whether man or monkey), and the virulence of the virus.

Vulnerability of motor neurones

Intranuclear inclusion bodies

The motor neurones of the cord and brain-stem, particularly those of the cervical and lumbar enlargements, are especially but not exclusively affected. They show a peculiar vulnerability to the virus not explained by any known facts but highly characteristic of the disease. In very acute cases they undergo acute necrosis, though in man slower degeneration, not necessarily irreversible, is more usual. Cells dying acutely are rapidly surrounded and partly lysed by polymorphonuclear leucocytes, and their remains are engulfed by microglial phagocytes; with slower degeneration microglial phagocytes alone may be concerned. In the early stages small spherical inclusion bodies may be present in the nuclei of affected cells.

Within a few hours of the onset of degeneration polymorphonuclear cells appear in the nervous tissues, to be replaced later by lymphocytes. Mobilization and multiplication of the microglia are largely responsible for considerable focal and diffuse increase in cellular infiltration in the grey and, to a less extent, in the white matter. The perivascular sheaths in the grey and, somewhat later, in the white matter become distended with lymphocytes and other mononuclear cells; in acute cases polymorphonuclear cells may also be represented in this exudate. As the sheaths fill with inflammatory cells, these drain into the pial meshes, and meningeal infiltration becomes a prominent histological feature.

Infiltration of nervous tissue

Although the motor cells are most heavily involved, others may succumb, e.g. those of the dorsal nucleus (Clarke's column) and of the spinal ganglia. In some bulbar cases the cord and these ganglia are relatively little affected. At levels above the brain-stem lesions are limited largely to perivascular cuffing, areas of meningeal infiltration, and parenchymatous foci of microglial increase, without marked destruction of nervous elements. In the motor cortex of monkeys, however, necrosis of some Betz cells occurs, and, although little attention has been directed to this specific point, similar appearances have been noted in a few fulminating human cases. These cortical lesions are probably not sufficiently intense or wide-spread to form an adequate anatomical basis for the cerebral type of the disease described by the older authors; there is not any record that virus has been isolated from such a case.

Other cells attacked

Lesions in motor cortex

During the stage of repair the glia proliferates. In old cases with residual paralysis the ventral-horn cells are reduced in number in affected segments, and there is compensatory glial sclerosis. The peripheral nerves undergo Wallerian degeneration, and permanently paralysed muscles atrophy. A limb paralysed in early life may grow more slowly than its fellow, and from this cause, or from the irregular involvement of different muscle groups, deformities may result.

Changes in stage of repair

In the cerebrospinal fluid the cell count may be only slightly increased or may reach 1,000 per c.mm. or more. Polymorphonuclear cells are of inconstant occurrence but may comprise 50 per cent of the whole; they are not necessarily limited to the early stages of the disease and probably indicate a certain type of reaction. Increase in protein occurs more slowly and outlasts the pleocytosis; thus the cell count may become normal within two or three weeks, leaving an increase of protein (as much as 300 mgm. per 100 c.c.) up to the seventh or eighth week or later. In such fluids a fine fibrin coagulum may form. The colloidal gold test may give a weak luetic curve (see also Vol. III, p. 65).

Cerebrospinal fluid

In the blood, leucocyte counts up to 30,000 have been recorded, with a rising proportion of polymorphonuclears up to the end of the second or third week.

Blood changes

4.–PATHOGENESIS

Portal of entry and path of transmission

In spite of attendant technical difficulties the consistent failure to detect virus in human blood renders it unlikely that this is the vehicle of transmission from the portal of entry to the central nervous system. On the contrary, all experimental work has emphasized the importance of the nervous pathway to the central nervous system. The distribution of virus already related, the frequency with which the disease follows intranasal instillation, the difficulty of inducing poliomyelitis by intravenous injection, and other considerations all point to the nasopharyngeal mucosa as the most frequent portal of entry in man and to the olfactory nerves as the pathway to the brain. It is not denied, however, that occasionally virus may ascend from areas supplied by other cranial nerves; thus, in cases with rapidly fatal bulbar involvement and little or no paralysis of the legs or arms the virus may possibly have ascended by one of the lower cranial nerves. The evidence in favour of infection by way of the gastro-intestinal tract is no longer accepted by most authorities.

Axis-cylinders as route of transmission

Until recently it was maintained that virus travelled along the perineural lymphatics and was further disseminated by the cerebrospinal fluid, but recent work casts some doubt on this belief. Except in the case of the olfactory nerves, it is not certain that the neural lymphatics connect with the cerebrospinal space. The facts (i) that in the experimental disease meningitis is not (in the cord) the primary phenomenon, (ii) that after intracerebral inoculation the contralateral limb is first paralysed more often than the homolateral, (iii) that after intrasciatic inoculation virus can be detected in the contralateral motor cortex before the homolateral, and that the leg area is infected before the arm area, and (iv) that after inoculation by any route the spread of virus and of lesions is such as might be expected from extension through the nervous tissues rather than by the medium of the cerebrospinal fluid, led Fairbrother and Hurst to conclude that the axis-cylinders might constitute the route of transmission. Jungeblut and Spring found that virus did not pass a point of complete transection of the spinal cord, though the flow of cerebrospinal fluid was unimpeded. After intranasal administration of virus Faber and Gebhardt obtained confirmatory evidence in favour of axonal spread, and Faber explained the whole symptomatology of the disease in terms of a progressive spread of virus, in abortive cases interrupted prematurely, from centre to centre on its path from the olfactory bulbs to the spinal cord. These conclusions imply that from an early stage of infection the virus occupies an intracellular position within the nervous system, and that there is not any preliminary 'systemic' phase of infection during which serum therapy might prevent the virus from penetrating the centres.

5.—IMMUNITY AND RESISTANCE

Second attacks

Second attacks of the disease in man are rare; nevertheless in 1934 Quigley collected twelve, and Flexner (1937) has since demonstrated the possibility of second or even third attacks in the monkey. After an attack antibodies neutralizing the virus *in vitro* usually appear in the serum. Although after appropriate vaccination in the monkey similar antibodies develop, many animals so vaccinated fail to resist intracerebral inoculation of virus. No satisfactory method of protecting man has yet been devised, nor has the value of immune serum as a therapeutic agent been established. Some evidence exists of slight serological differences between diverse strains of virus.

Formation of antibodies

Susceptibility

Infants under one year of age are relatively insusceptible, a fact attributed by some to the transmission of protective substances from mother to child. After infancy follows the age of maximal incidence of the disease, though in recent years a general upward trend in the age incidence has been noted. A majority of urban adults possess neutralizing antibodies, often to a greater extent than do some convalescents. This observation and the known prevalence of mild febrile illnesses in children during epidemic periods suggest that most persons contract poliomyelitis as a scarcely apparent infection or become immune as a result of one or more exposures to the virus. In the blood of close contacts with frank cases of the disease Kramer (1932) observed the development of immune bodies in the absence of any clinical evidence of infection. On this basis can be readily explained the difficulty in many epidemics in tracing connexion between paralysed cases. Draper believed that the paralytic form of poliomyelitis occurred in a particular type of person in whom there was evidence of pituitary, gonad, and adrenal cortex deficiency and a general tendency to status lymphaticus. Another view of adult insusceptibility, championed by Jungeblut (1932), postulates increased resistance resulting from physiological maturation and due to hormonal and other non-specific factors. Several epidemics in 'virgin-soil' communities have not altogether supported this view.

6.–EPIDEMIOLOGY

Since the publication of Wickman's observations it has been generally held that the infection is spread and carried by healthy carriers of the virus (perhaps 'subclinical infections') and by sufferers from the disease. From the nasopharynx of both groups the virus has been isolated, and Flexner and Amoss concluded that the nasopharyngeal mucosa contained the active virus for about ten days after the onset of clinical symptoms. Nothing is certainly known of the existence of chronic carriers. In other words, poliomyelitis is a human-borne contagious infection and travels along the routes of human traffic.

Isolation of infected communities

It has been suggested that only healthy carriers spread the disease, and that once symptoms appear the subject is no longer infective, and it has also been said that in a given community all susceptible subjects are at once infected, and that further spread of the disease does not occur within that community. But the study of community infections, as it may be made from the papers of Wickman and others, does not bear out these opinions, and it is certain that within a closed community fresh cases may appear at intervals over a long period. This point is important in connexion with such communities as boarding-schools. It has been urged that once infection appears within such a community, it should be isolated and kept together, because all susceptible subjects within it will be infected at the outset, and that those not then infected are safe from later infection. The records of epidemics in relatively closed communities do not bear out this hypothesis. Infection smoulders for weeks, and every child thus quarantined remains liable for an indefinite period to contract the disease. In a word, the child is not safe under these conditions, and his removal from the infective community is in his own interests indicated. It is clear, however, that contacts removed from an infected community should be segregated from other children outside it until the period of possible infectivity—the incubation period has passed. The length of this is estimated to be ten to twelve days.

Incubation period

Transmission by milk

There is some evidence that milk may act as a vehicle of infection, though this has not been proved conclusively.

Age incidence

The maximal incidence is within the first five years of life. After this it progressively diminishes through childhood and adolescence. Adult cases occur—in the third and rarely in the fourth decades of life—but except during epidemics of the disease they are uncommon.

7.—CLINICAL PICTURE

It is customary to describe the clinical course of poliomyelitis under the headings of (i) the pre-paralytic and (ii) the paralytic stages, subdividing the latter into acute and convalescent periods.

Abortive cases

During the course of an epidemic outbreak, there is reason to think that more than half the total of infected persons recover from the infection without developing paralytic symptoms. These are the so-called abortive cases. Poliomyelitis was formerly thought to be a general infection, with subsequent invasion of the nervous system. It was then thought that in abortive cases the infection died out before this invasion took place. As the earlier sections of this article have made clear, this view is no longer held, and an abortive case is now regarded as one in which the primary invasion of the nervous system has taken place, but the natural processes of resistance have sufficed to destroy or inactivate the virus before it has had time to damage the motor nerve-cells severely enough to cause paralysis. In abortive as in paralysed cases the nervous system is infected, and every clinical symptom of the pre-paralytic stage of the illness expresses this infection.

Explanation of abortive cases

Subclinical infection

Some persons may harbour the infection and show no signs whatever. These are the so-called subclinical infections that may play a considerable part in the spread of the disease.

The pre-paralytic stage

General appearance

This initial stage is commonly a short-lived febrile illness which, except during epidemic outbreaks and in the hands of those very familiar with its features, often escapes recognition. The temperature may rise to 103° or 104° F. The child may be irritable and resentful and has a tense 'strung-up' demeanour which is said to be typical of this febrile illness as compared with the other infections of childhood. As the virus makes its way from its point of entry in the nervous system, through the hypothalamic region and the brain-stem, reaching the dorsal-root ganglia and finally the ventral-horn cells, the clinical picture takes on some of the aspects of an acute leptomeningitis. There are headache and pain in the back, and the neck and spine become stiff. Kernig's sign may be obtained, voluntary movements are apt to be jerky, and involuntary twitchings of the limbs may be seen. In the most severe infection the child may become drowsy and even stuporose.

Meningeal signs

In a few hours to a day or two the temperature falls. The child may then rapidly regain normal health in the 'abortive' case, or, alternatively, after a short interval of a few afebrile hours paralysis suddenly appears; this development is occasionally marked by a second transient rise of temperature, but from this point onwards the illness is usually afebrile, and the signs of meningeal irritation disappear.

Development of paralysis

During this stage examination of the cerebrospinal fluid shows characteristic changes, some of which have already been enumerated. These changes differ from those of an acute meningitis by the absence of any lowering of the chloride or glucose contents of the fluid and by the absence of discoverable organisms. Within a few days of the appearance of the paralytic stage the fluid regains its normal composition.

Cerebrospina fluid

The paralytic stage

As a rule the onset of paralysis is sudden, and its distribution and intensity are maximal at once. But during epidemic outbreaks, particularly in the case of adolescent and adult sufferers, it may increase both in distribution and intensity within the three or four days after its first appearance. This may happen by an 'ascending' type of spread, the paralysis appearing first in the lower limbs and rising progressively to involve the abdominal and back muscles, then those of the thorax and finally, in fatal cases, those of the neck, the subject dying of respiratory failure as the respiratory muscles succumb to paralysis. Sometimes this rise ceases before a fatal issue is reached, and the paralysis then recedes like a falling tide, so that the patient survives with a greater or less degree of paralysis in trunk and limb muscles. Death is due to paralysis of respiratory muscles. In other cases the paralysis increases by 'jumps', appearing in limb after limb over a period of three or four days, with intervals of twelve or more hours between 'jumps'. In these circumstances also respiratory muscles may be involved with fatal consequences.

'Ascending' spread of the paralysis

Spread of paralysis by 'jumps'

In the spinal type, which provides the great majority of all paralysed

Paralysis in spinal type

cases, the distribution of the paralysis is inconstant. The muscles of the legs are the most frequently and usually the most severely affected, but even these not uniformly, so that some muscles in the limb may be totally paralysed while others escape. The dorsi-flexor muscles and quadriceps tend to be the most constantly and most severely affected. The abdominal and back muscles may also be affected, but these also asymmetrically and unequally. In the upper limbs the deltoid and scapular muscles, particularly the former, commonly bear the brunt of the paralysis.

Thus there is a wide range of clinical pictures, from one in which a single deltoid muscle is paralysed to others in which almost every limb, the trunk, and the neck muscles are more or less severely weakened.

Pain and tenderness

For a period varying from one to five or six weeks the affected muscles are painful to pressure and on stretching, and, while this pain endures, the patient is said to be in the acute period of the illness. When pain and tenderness finally pass, he is said to have entered the convalescent period. The degree and distribution of pain and tenderness vary from case to case. Usually muscles which are but slightly paralysed are the most tender, and sometimes the most widely and severely paralysed cases are virtually painless from the onset.

Resultant changes in muscles

Since the seat of the lesion responsible for this paralysis is the ventral-horn cell, i.e. the lower motor neurone, the affected muscles are more or less cut off from the central nervous system and may be said to be denervated. Certain consequences follow from this: loss of tendon-jerks in affected muscles, muscular flaccidity, and, in due course, wasting of muscles.

Sensation

Sphincters

Reflexes

Sensation remains intact, and the sphincters are not paralysed. However, in cases in which the legs are both severely paralysed there may be retention of urine for two or three days, normal control being then spontaneously re-established. In addition, it occasionally happens in such cases that the intensity of the inflammation in the affected region of the cord leads to spreading oedema into the white matter. This may lead to a transitory extensor plantar-response in one or both feet.

Convalescent period

With the disappearance of muscular pain and tenderness the patient's general condition rapidly becomes normal, and the long convalescent period of the disease—which may endure for two or three years according to the severity and extent of the paralysis—is entered upon.

Degrees of damage to nerves and muscles

The paralysed muscles may now be considered as falling into three categories. (i) Those whose motor nerve-cells have been completely destroyed, i.e. those which are totally denervated; these will never recover any power, and they begin to waste, a process which goes on until no contractile elements remain and the muscle becomes a fibrous strand. (ii) Those whose motor nerve-cells are extensively and severely damaged, only relatively few motor cells remaining in full activity; wasting begins in these muscles also but is not complete, and with the passage of weeks and months, sometimes of years, they regain a fraction of their original bulk and power but remain permanently weak and wasted.

(iii) Those whose motor nerve-cells are but slightly and temporarily damaged. These begin to recover strength early in the convalescent period. They do not waste appreciably—or but temporarily—and they regain full bulk and power within a few weeks or months.

It is in the early weeks of the convalescent period that it first becomes possible to determine into which of these categories the affected muscles must be placed and a prognosis of the degree of recovery of power becomes practicable.

Recovery

The recovery process is most striking at first, but gradually slows down, and after the lapse of three years it is doubtful if further restoration ever occurs. This statement assumes that the patient is dealt with under the most favourable conditions from the outset, for a patient neglected at first may show increased rate and degree of improvement at a later period if suitable measures are taken, and it is to this fact that unduly enthusiastic claims for certain special modes of treatment owe some of their undeserved renown.

Sometimes a limb imperfectly recovered from an old poliomyelitic paralysis may years later show an increase of weakness and begin to waste anew. This happens more commonly in a leg than in an arm, and it is probable that excessive use of weakened muscles is responsible.

Polio-encephalitis

The symptoms in the cases of so-called polioencephalitis indicate nerve-cell damage in the regions of the brain named: thus in the cerebral form there are convulsions and coma followed by hemiplegia; in the cerebellar form an acute cerebellar ataxy; and in the brain-stem (usually pontine) form cranial-nerve palsies. But it is no longer regarded as proved that the undoubted cases which have been recorded of acute brain lesion presenting these symptoms have been really cases of the true poliomyelitic infection. Other, as yet unknown, infections of the nervous system are probably responsible, especially for the cerebral and cerebellar forms. In this connexion it is significant that intracerebral inoculation of the poliomyelitis virus into monkeys invariably produces the spinal type of the disease. Cerebral forms cannot be produced experimentally, no matter what the site of virus inoculation. The earlier experimental observers described occasional cerebral types in monkeys, but in his more recent work Hurst has been unable to confirm this. Perhaps the occasional occurrence of a pontine type must be accepted; the common expression of this is a facial palsy. I have observed paralysis of the soft palate with regurgitation of fluids through the nose and a nasal voice in an undoubted case of poliomyelitis with characteristic paralyses of spinal cord origin. On the whole, the so-called poliomyelitis of children giving the cerebral symptoms and signs noted above is probably not true acute poliomyelitis.

8.–PROGNOSIS

Cause of death

Unless respiratory muscles are paralysed the patient will survive, and even when these are seriously weakened this weakness may be transient and may clear up before respiratory failure can ensue. In fatal cases, as the respiratory muscles weaken and respiration becomes more difficult, the accessory muscles in the neck are called into play, and the patient preserves absolute immobility, carefully avoiding all exertion, even that of speech, in order the better to maintain the respiratory bellows. He becomes progressively more cyanosed, the respirations become more rapid and shallower, he sweats freely and—with consciousness usually completely maintained—dies of respiratory failure.

Prospect of recovery

The prognosis of recovery of power in paralysed muscles necessarily varies. Many patients survive with wide-spread and severe paralysis and muscular wasting, the limbs and trunk muscles all being affected. Thus a life of profound physical helplessness may ensue and be indefinitely prolonged as a bedridden existence in which the patient must be fed and in every way cared for. Between this distressing extreme and complete recovery all grades of partial paralysis of few or of many muscles are seen. The three categories into which affected muscles may be placed have already been mentioned, and it is during the first months of the convalescent period that an assessment of the future becomes possible.

When the legs are profoundly and permanently paralysed, the feet and dependent parts tend to become cold and cyanosed, the seat of chilblains and sometimes of trophic lesions. Contractures and deformities may also occur as the fibrous tissue in the wasted muscles shortens with the passage of time. When the chest muscles are permanently weakened, an attack of bronchitis or of pneumonia may easily lead to a fatal issue.

9.–DIAGNOSIS AND DIFFERENTIAL DIAGNOSIS

It has already been mentioned that diagnosis in the pre-paralytic stage is apt to be difficult in a sporadic case of the disease, for the symptoms may be so trivial as to lead to their being regarded as a 'cold', or as 'influenza', or as some other common disorder of childhood; on the other hand, meningeal symptoms may be so striking as to lead to the suspicion of an acute meningitis. Finally, in a few cases the discovery of paralysis may be the initial indication that the child has poliomyelitis, all preliminary manifestations having been absent.

Diagnosis from meningitis

If symptoms suggesting meningitis are present, a differential diagnosis may be made by the examination of the cerebrospinal fluid, when the reduction in chloride and glucose contents so characteristic of acute meningeal infection will be lacking. Also, the transience of the condition and the fall of temperature on the second, third, or fourth day will soon exclude this possibility. Finally, the onset, characters, and distribution of paralysis of muscles establish the diagnosis.

Diagnosis of mild cases

Cases apt to escape recognition are those in which the muscles affected are few in number and the loss of power slight or those few in which there is wide-spread but relatively slight weakness. When activity is resumed after the febrile stage is passed, the weakness present may be attributed to debility, but careful examination should suffice to avert this error, for the weakness is unequally distributed, and one or more tendon-jerks are missing.

Diagnosis from polyneuritis

Confusion with polyneuritis, commonly diphtheritic in children, should not occur, for polyneuritis is symmetrical in distribution and involves the lower more severely than the upper limbs and distal more than proximal limb muscles. In addition there is commonly some impairment of all kinds of sensation in the distal parts of the limb, and during the active stage of the malady the heart-rate is always increased above normal.

An occasional feature that may cause some difficulty in diagnosis is the liability of the paralysis to affect, and to be confined to, an injured part. Several cases are on record in which the paralysis has appeared in a very recently fractured limb, and, when it is so localized, the concurrence of an attack of poliomyelitis may not be recognized.

10.–TREATMENT

This may be considered as treatment of (i) the infection and (ii) the paralysis.

The infection

'Convalescent serum'

It must be confessed that there is no specific means of combating the infection. For twenty-five years it was believed that the administration of so-called 'convalescent serum', i.e. the serum of recovered patients, which is known to contain protective bodies, would avert paralysis if administered in the pre-paralytic stage or at least minimize the extent and severity of paralysis. But careful reconsideration of the evidence and more recent control observations have shown this belief to be illusory. This is what the experimental evidence might have suggested, for, unless protective serum is administered to an experimental monkey either at the same time as the virus is inoculated or within twelve hours of this and before any symptoms whatever appear, it is wholly inefficacious to control or in any degree to mitigate the severity of the subsequent paralysis. In man serum cannot be given until recognizable symptoms make diagnosis possible, i.e. when it is too late and the virus is already fixed in the motor nerve-cells.

Serum as prophylactic

Therefore the only possible scope of usefulness for convalescent serum is its administration to susceptible contacts and as a prophylactic. For this purpose 25 to 50 c.c. of the serum may be given intramuscularly. Its intrathecal administration is no longer recommended. There is some reason for thinking that a blood transfusion from a suitable donor may possibly serve the same purpose, for the blood of most adults has some protective value, but the method has not been adequately tried or evaluated.

Specific serum therapy being thus ruled out, there is no means whatever of controlling the infection; there is no chemotherapy of any value for this purpose.

General treatment

It is a sound rule that, once the disease is suspected, the child should be kept as quiet as possible and not moved or transported unless it is imperative to do so. Since the nasopharyngeal secretions and probably the excreta are infective for some two weeks after the onset, the usual measures should be adopted to deal with these. In a hospital, bed isolation is adequate.

Gargles

The use of a mouth-wash and gargle of weak potassium permanganate solution is probably advisable and may also be adopted by those in attendance on the patient.

The paralysis

During acute stage

During the acute stage, i.e. while pain and tenderness persist, no active local treatment is undertaken. The essentials of treatment at this stage are rest and relaxation of muscles. As far as possible all affected muscles should be in a position of relaxation. If the deltoid is paralysed, the arm should be abducted forthwith and so maintained, semi-adduction being allowed for short periods if the pectoralis major is affected. The patient should lie supine with the legs extended and adducted, and the feet should be kept at right angles to the legs. On no account should he be allowed to sit up until it has been ascertained that the spinal muscles are intact or, if weakened, until he is supported by an adequate spinal jacket. No massage should be attempted at this stage. Pain can usually be kept in check by the regular administration of aspirin. Sleeplessness for the first week or two may need to be dealt with by bromide and chloral hydrate if aspirin proves inadequate for this purpose.

Diet

As soon as the temperature has fallen and the child's general condition is good, a generous diet should be begun.

Respirators

Recently special measures have been devised for threatened respiratory paralysis. These consist in the use of an apparatus which performs artificial respiration. The first and best known of these is the Drinker respirator (see p. 598), a metal cabinet in which the patient lies supine, only the head protruding through a rubber collar which surrounds the neck. Alternate positive and negative pressures at an appropriate rhythm are produced by means of a motor. The patient can be fed without removal from the respirator, and port-holes in it allow of the necessary nursing care. A simpler device is the Bragg-Paul respirator (see p. 599), an apparatus which is fixed round the chest and performs the same passive movements of the chest as are secured somewhat differently in the Drinker machine. In this device the care of the patient is a much simpler matter.

By one or other of these machines the patient may be kept alive until, with the receding of an ascending or other paralysis of the respiratory muscles, voluntary respiration becomes possible again. This happy result does not always ensue; cases are on record in which sustained life has been possible only by permanent retention in the respirator, a situation the distressing possibilities of which need not be emphasized. Again, although respiratory movements may regain sufficient strength to allow of removal from the respirator, the patient may yet be left profoundly helpless and bedridden for the remainder of his days.

What can be called a really successful result, i.e. one in which the resumption of some degree of physical activity and usefulness ensues, must be rare indeed. In short, it is probable that respirators will find their chief field of usefulness in conditions other than the paralysis of acute poliomyelitis.

Active treatment in convalescent period

Active local treatment begins with the convalescent period and consists in active and passive movements and, for totally paralysed muscles especially, massage. Re-education of muscles is the most essential and important feature throughout the entire convalescent period.

Support for weakened muscles

If the spinal muscles are weakened, the child should not be allowed to sit up until a spinal support has been provided, for otherwise kyphosis and kyphoscoliosis develop rapidly and may become permanent. In general it is wise to mobilize the patient as soon as possible, by the use of splints if necessary, for he should not be allowed to carry weight on weakened limbs if damage to joints and their ligaments and stretching of weak muscles are to be avoided. Calliper splints may be necessary to get the patient on to his feet.

Night shoes may be necessary in bed to avert foot-drop; effective and light splints for this purpose may easily be made from cardboard, adhesive strapping, and cotton-wool. The lightest possible supports should always be used.

Massage

For totally paralysed muscles massage (effleurage, gentle kneading, and tapotement) should be employed, not as a curative agent, for this it cannot be, but to maintain the circulation in the inactive muscles. When voluntary contraction is present, active re-education of muscles takes first place in treatment, but full lengthening of very weak muscles should not be allowed, nor should they be allowed to carry weight, i.e. their movements must be assisted by the masseur who supports and partly moves the limb. (See Vol. VIII, p. 382.)

Electro-therapy contra-indicated

More active movements may be performed by less weakened muscles. These procedures need constant supervision, for they become monotonous and are neglected by the child if left to himself, and they should not be persisted in too long at a time so as to exhaust him. Massage is not a substitute for active exercises. It has long since been satisfactorily demonstrated that wasting is not averted and recovery not hastened by electrical stimulation of muscles, and it may therefore be emphasized that electrotherapy has no place in the treatment of poliomyelitis. This is a saying that many patients and their relations, and even their doctors, find hard, for considerable claims have been made for this form of procedure both in the acute and the convalescent stages. In the acute stage electrically produced heat (diathermy) has been said to reduce oedema in the cord and thus to promote circulation and recovery of function, but this statement wholly lacks substantiation. In the later

Diathermy

stages it is indeed possible that local heat, however produced, improves the circulation in paralysed limbs and thus helps to maintain such muscle as there is until active innervation is restored, but clearly none of these procedures can have any influence upon the lesion in the damaged neurones, and too much must not be expected of them.

Exercises in swimming-bath

For some cases exercises in a warm swimming-bath are of great value, for the water helps to carry the body-weight and allows of a great diversity of movements.

Accurate prescription of physical treatment

The physical treatment of a case of poliomyelitis may continue for two or three years and during this time calls for constant supervision and alteration as power is regained. It cannot be left to the unfettered discretion of a masseuse or masseur. A plan should be drawn up for each case; the range of active and passive movement to be allowed for a given muscle group and the degree of assistance needed should be specified. The amount and kind of massage and the muscles to which it must be given should also be prescribed. Only by a sustained study of each case can treatment be prevented from degenerating into a routine of perfunctory rubbing of muscles, with a neglect of those remedial exercises which are the essence of successful treatment.

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POLYDACTYLY

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PORPHYRINURIA

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POST-MORTEM EXAMINATION

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Reference may also be made to the following titles:

ASPHYXIA
ASPHYXIA IN CHILDREN
CORONERS AND INQUESTS
DEATH, SUDDEN AND UNEXPECTED
DROWNING: RESUSCITATION
TOXICOLOGY

1.–INTRODUCTION

Medico-legal aspect 1283.] From a medico-legal point of view the object of a post-mortem examination is to find the cause of death and to discover whether this was 'natural' or not. By 'natural' is meant any disease naturally acquired as distinct from one resulting from injury, poisoning, or other process which could be brought about by any illegal or accidental means.

Pathological aspect

The pathologist's approach is somewhat different. Pathology is concerned with processes and not with clinical states and generally with the reaction of the body to disease and injuries. The object of a post-mortem examination from the pathologist's point of view is to analyse the changes in each organ so as to arrive at a coherent account of the processes which have been active in the body. Death usually interrupts these processes. It may have no relation whatever to the processes which interest the pathologist most, or it may be the final stage in the development of these processes.

2.–TECHNIQUE

Whether the post-mortem examination is made for a medico-legal or for a pathological purpose, the whole of the body should be thoroughly examined. A technique should be adopted which will ensure that each organ will be examined both separately and in relation to the other organs of the body. Since pathologists develop a more or less individual technique, this article is intended for practitioners who do not regularly perform post-mortem examinations; a single straightforward technique will therefore be described. It is not absolutely necessary to follow this technique rigidly; but, if it is followed as closely as possible, little will be missed, and the operator's conclusions will be more valuable than if the organs are examined in a haphazard way or merely for a preconceived lesion.

It is important, especially in medico-legal cases, to obtain information about the patient's condition in life. If the patient was found dead, information should be obtained about the position and circumstances in which the body was found. This information is important and should never be ignored; but it is necessary that the post-mortem examination should be completed and all information derived from it and other sources carefully weighed before a final verdict is given.

(1)—External Examination

Rigor mortis

External injuries

Identificatio

The first step is to examine the body systematically, beginning at the head and passing to chest, arms, abdomen, legs, and feet. The ease with which a limb can be moved indicates the degree of rigor mortis. The colour of the nails and lips should be noted; they may be cyanosed or abnormally pale. The body should be turned over and the back examined. It is particularly important in medico-legal examinations to write full descriptions of external injuries, giving measurements, sites, and appearances, before continuing the examination. Incisions into wounds of any kind should be made with a sharp knife at right angles to linear wounds and across punctured or irregular wounds. The incisions should be clean-cut and planned to avoid any subsequent confusion between wound and post-mortem incision. Unidentified bodies should be carefully examined for, and a record made of, any features that may help in their subsequent identification.

(2)—Opening the Body

The most important rule of all is to look before cutting and not to cut without seeing what is being done. The skin incision should be planned to give the maximal access to the organs, and, when sewn up, to leave the minimal disfigurement of the body.

Incision of skin

The incision should begin at the tip of the mastoid process and continue along the posterior border of the sternocleidomastoid muscle on each side so as to form a wide V, meeting in the middle line on the chest about the level of the fourth rib.

From this point the incision should continue in the middle line to the pubes, keeping just to the left of the umbilicus, because in infants the umbilical vein and hypogastric arteries should be examined with care; if they are severed by the incision, pus or blood-clot may escape undetected. The V-shaped piece of skin together with subcutaneous fat and platysma is reflected upwards until the lower jaw is exposed.

Of peritoneum

The peritoneum is opened in the middle line, care being taken to prevent the escape of gastric or intestinal contents into the peritoneal cavity. On opening the peritoneal cavity, in addition to the examination of the viscera, it must not be forgotten to feel for hernial orifices, and this is best done at the earliest opportunity.

The skin, subcutaneous tissues, and muscles are reflected from the chest, and the connexions of the diaphragm to the anterior abdominal wall are cut through.

Of costal cartilages

The costal cartilages are incised so as to leave a cap of cartilage on the ribs. After cutting through all but the first costal cartilages, it is advisable to raise the sternum and examine the pleural cavities, because, unless the operator is particularly skilful, he is liable to cut the great veins of the mediastinum and so to contaminate any fluid that may be in these cavities. The sternoclavicular joint and the first costal cartilage are cut through, and the sternum with its attached costal cartilages is removed entire.

It helps if the recti abdominis muscles are cut from their attachment to the pelvis, either beginning in the subcutaneous tissues and cutting towards the peritoneum or cutting from the peritoneal surface to the subcutaneous tissues. After removal of the thoracic viscera (as described below), the attachments of the diaphragm to the chest wall should be cut through.

(3)—Removal of Organs

It is most important to examine all organs *in situ* before attempting to remove them, and to inspect the pleural, pericardial, and peritoneal cavities before their contents have become contaminated by blood or other fluid.

Neck

The soft tissues round the inner side of the lower jaw should be cut as close to the bone as possible. The tongue then falls forwards; the soft palate should be cut through and all the viscera and tissues of the neck freed as far back as the prevertebral fascia. These organs are removed with heart, lungs, oesophagus, and aorta as one specimen as follows. If the pleural cavities contain pus, blood, or other fluid, this should be measured and the cavities emptied. The pericardium is opened by an L-shaped incision passing from the diaphragm to the region of the aorta in the middle line and from the lower end of this incision to the apex of the heart. Care should be taken to prevent the escape of blood into the pericardial cavity. The pleura on either side of the vertebral column is then incised, and the neck organs are pulled gently forwards until the aorta and oesophagus are free as far as the level of the diaphragm. The oesophagus is then tied or clamped off and cut through. The aorta and inferior vena cava are also cut through at this level, and the pericardium is dissected from the diaphragm. The pulmonary artery should always be opened and the blood-clot in it examined before the heart is separated from the lungs. Unless this is done, pulmonary emboli may be missed; those that lie curled up in the main pulmonary artery are liable to be washed out of the cut end of the artery by fluid blood proximal to them.

Thorax

Pericardium

Pulmonary artery

The heart may be opened *in situ* or after taking the neck viscera, heart, and lungs all out together. The incisions are: (i) in the right border, extending through the auricle, tricuspid valve, and ventricle to the apex; (ii) from the former incision near the apex, keeping on the right of the septum, up to the pulmonary artery, which should be opened until its bifurcation can be clearly seen; the heart is removed by cutting through the aorta and pulmonary artery at the level of the transverse sinus and through the pulmonary veins and venae cavae where they penetrate the pericardium; (iii) parallel to, but just to the left of the septum, reaching from the apex to the aortic valve and continuing into the aorta; and (iv) in the left border of the heart, through auricle, mitral valve, and ventricle to the apex, where it joins incision (iii). These incisions are so designed that the organ can be fully examined and later restored to its original shape.

Heart

The coronary arteries are next opened as far as their smallest branches. The usual procedure is to open them up with blunt-ended scissors, and in most cases this is quite satisfactory; but small thrombi may be pushed along or removed by the scissors and so missed. An opened artery seldom gives the same impression of diminution of its lumen as a transverse section of an unopened artery, so that in cases in which coronary thrombosis is suspected, or if difficulty is experienced in opening the arteries with scissors, it is a good plan to make transverse sections with a knife at short intervals throughout the course of the arteries.

Coronary arteries

After removal of the heart, the specimen should be turned over and the oesophagus opened in the middle line; then the larynx should be opened in the middle line through the thyroid cartilage, and the incision prolonged through the right wall of the trachea into the main bronchi to preserve the oesophagus comparatively intact.

Oesophagus

Aorta
Lungs

The lungs should be removed by cutting through the tissues at the hilum. Thyroid, tongue, glands, parathyroids, and tonsils are all examined. The aorta and its main branches are opened up and examined. The lungs are incised through their posterior borders so as to open up the main bronchi and blood-vessels. Should the incision fail to open these, they can be opened with scissors.

Intestines

The small intestine, from the duodeno-jejunal junction distally, is removed by an incision through its mesenteric attachment as close as possible to the intestine; this is best done with an organ knife. The colon and appendix are removed with blunt-ended scissors, the last few inches of the pelvic colon and rectum being left for the time being. The small intestine is opened along the line of its mesenteric attachment and the colon along one of the taeniae.

Bile passages

The duodenum should be opened along its convex border, the gall-bladder gently pressed, and the bile passages massaged to see if there is free passage of bile from the ampulla. Should there be any obstruction, it is as well to take out the liver and stomach together with duodenum, pancreas, and spleen as a single specimen before dissecting and opening the bile-ducts.

Stomach

Stomach, duodenum, pancreas, and spleen are removed together, particular attention being paid to the bile-ducts, hepatic artery, and portal vein before they are cut through. The stomach is opened along its greater curvature, the spleen incised in its long axis, and the pancreas examined throughout.

Liver

It may be found easier to remove the liver before the stomach, duodenum, pancreas, and spleen. The liver after removal should be incised in several places, the incisions all being made parallel to the upper border and passing through the whole thickness of the organ. The gall-bladder and bile-ducts should be opened and their walls and contents examined.

The inferior vena cava should be opened and the ostia of the hepatic veins examined.

Adrenals
Kidneys

The adrenals should be removed in a definite order, e.g. the left first, because this makes it easier to remember which is which after removal. The same applies to the kidneys. It is also advisable to leave a greater length of ureter attached to one kidney than to the other, the longer portion preferably being attached to the left kidney. Before removal as much fat as possible should be dissected from the kidney, and the ureter should be examined and traced as far as the pelvic brim. The renal blood-vessels should be examined before being cut through. The kidneys are incised through their outer border, the incision passing through the whole substance of the organ so as to lay open the renal pelvis.

Should there be dilatation of one or both ureters, it is often advisable to remove both kidneys, ureters, urinary bladder, and urethra as one specimen.

Aorta

The aorta, the common, internal, and external iliac arteries, the inferior vena cava, and the common, internal, and external iliac veins should be opened up, and any clot carefully examined because post-mortem clot is not uncommonly deposited on, and so masks, antemortem clot.

Pelvic organs

The pelvic organs are removed *en masse*. The peritoneum is cut round the posterior and lateral brims of the pelvis and the incision prolonged outside the peritoneum so as to remove all the pelvic organs intact. It is a great help to hold the rectum and bladder in one hand, pulling gently while cutting.

Rectum
Bladder
Uterus

The rectum should be opened through its posterior surface, the urethra and bladder in their anterior middle line, and the vagina and uterus through their right wall.

Testicles

The inguinal canal should be opened, the cord being pulled gently to bring the testis up from the scrotum. The tunica vaginalis should be cut through and the testis incised in its long axis from the outer border towards the hilum. The epididymis should be examined and incised.

Brain

The incision in the skin of the head passes from side to side over the vertex to join the previous incisions at the mastoid processes. The skin and subcutaneous tissues are then stripped forwards and backwards, the anterior flap being stripped to the level of the orbits and the posterior flap to the lower border of the occipital bone.

Removal of skull cap

The cranial incision is made through the frontal bone a little above the level of the eyebrows and continued backwards through the squamae of the temporal bones to the mastoid portions in such a way that, if it completely encircled the head, it would pass through the occipital point, i.e. that portion of the occipital bone farthest from the root of the nose. The two ends of this incision are joined by an oblique cut passing across the back of the skull through the sagittal suture at the junction of its anterior two-thirds with its posterior third. Care should be taken not to damage the dura mater with the saw. The skull cap should next be gently raised from the dura mater with a T-shaped chisel and, if necessary, a periosteal separator.

Removal of brain

The superior sagittal sinus should next be opened and examined. The dura mater is then cut round at the same level as the bone, the falx cerebri cut through its anterior attachment, and the brain removed by gently raising the olfactory nerves and cutting through all others, by cutting the tentorium cerebelli at its attachment to the petrous portions of the temporal bones, and by cutting through the uppermost part of the cervical cord. The brain is first examined at the base, careful observation being made of the arachnoid and the contents of the basal cisterns. Then the main arteries should be carefully dissected. Transverse incisions are made through the medulla and pons. When these have been examined, the brain should be turned over, the two lobes gently drawn apart, and the corpus callosum incised from front to back so as to open the lateral ventricle on each side, and incisions are made through the walls of the lateral ventricles throughout their length, so that the brain opens out rather like a book. Transverse incisions should then be made through the caudate nucleus, internal capsule, optic thalamus, and lenticular nucleus; if these are made at the same level on each side, the two sides can be compared. A vertical incision through the long axis of the vermis so as to open the fourth ventricle, a horizontal incision passing from the middle line through each lobe of the cerebellum, and several smaller vertical incisions through the dentate nuclei are made. The lateral sinuses are opened up throughout their length.

The dura mater of the whole skull should be stripped so as to expose the bone; it is impossible to make a proper examination for fractures without doing this. The roofs of the middle ears can be chiselled through so as to expose the ossicles and the mastoid cells. To remove the pituitary, the dura mater roofing over the sella turcica should be incised and the posterior clinoid processes carefully chiselled away. Unless these precautions are taken, the anterior lobe will be damaged and the posterior lobe ruined.

Urethra It is often important to examine the urethra in cases of hypertrophy and dilatation of the bladder in the male, and, unless the greater part of the urethra is removed intact and attached to the bladder, it is seldom possible to demonstrate a stricture. This removal requires practice before it can be carried out effectively, easily, and without causing considerable disfigurement. The skin is undercut from the pubic bone and the body of the penis freed by blunt subcutaneous dissection to a point just short of the glans. Here it can be cut through, and then, with a knife passed carefully between it and the pubic arch, its attachments to the arch can be cut through. It can then be threaded backwards through this opening and removed together with the prostate and bladder. It helps considerably if, when the triangular ligament has been incised sufficiently to enable the penis to be pushed back into the pelvis, blunt-ended scissors are passed down the external surface of the pubic bones and the fat and fibrous tissue attached to the bulb of the penis cut through. After the removal of the penis, prostate, and bladder, the urethral canal should be opened up through its anterior surface (through the corpora cavernosa) and this cut continued in the middle line of the bladder as far as its upper surface.

Spinal cord Removal of the spinal cord is laborious rather than difficult. The body should be turned on to its face, and the chest should be supported by a block, so that the back is slightly arched and the head hangs down. It is important, however, to avoid too much arching, because this produces tension on the cord and may damage it. The incision is made in the middle line from the head to the sacrum. The skin, subcutaneous tissues, and muscles are then reflected on either side. The spines of the vertebrae thus exposed should be cut through with bone forceps. This exposes the posterior surface of the spinal arches, from which it is important to scrape as much muscle as possible. Unless a clear view is obtained of the laminae in this way, it is impossible to make accurate saw cuts, and either the cord will suffer or it will be extremely difficult to get a satisfactory exposure. The saw cuts are made through the laminae as far from the middle line as possible without involving the canals from which the posterior roots emerge. The easiest place to begin the saw cuts is in the dorsal region, and the saw blade should slant slightly towards the middle line; all the laminae from the first cervical to the last lumbar should be cut through. The laminae are then removed with bone forceps. If the bone forceps is used as a lever, pressure should be made only upon bony surfaces and never upon the cord. If the saw cuts have been made satisfactorily, the whole of the posterior part of the arches comes away in one long ribbon, and very little cutting is necessary with bone forceps. Further, the cord is exposed throughout its length, and its membranes and nerves are intact. To remove the cord, a pair of Spencer Wells or Kocher forceps should be attached to the dura mater covering the cauda equina; then the dura mater should be pulled gently to one side with ordinary dissecting forceps and the nerve roots cut through with a sharp scalpel. When this is completed, the attachment of the dura mater to the posterior aspect of the skull can be cut through with a scalpel. The dura mater and the nerves distal to the Spencer Wells forceps are cut through, the cord is gently raised from its bed, and all attachments to the posterior surfaces of the bodies of the vertebrae are cut through. The cord should not be pulled but should be kept straight and taut during this manœuvre; it is most important that the cord should not be bent or otherwise pressed, because post-mortem damage to a cord may easily obliterate any traces of ante-mortem damage.

The dura mater can now be cut through its lateral and anterior attachments to the skull. The cord will now be free and can be removed for examination. It should be laid on a tray or a table and the posterior surface of the dura mater incised in the middle line with scissors. If this is done carefully, the pia-arachnoid will be left intact enclosing fluid or other contents. The cord and its membranes should be examined and transverse incisions made through the cord at various levels. These incisions must be made with a sharp and preferably moist knife and enable the cord to be bent when introduced into a fixative or for any other purpose.

(4)—Post-Mortem Examinations for Coroners

The procedure outlined above should be followed in making post-mortem examinations for a coroner. It is important to obtain as much information as possible about the case from the coroner's officer, as knowledge of the position of the body and its condition when found will often save the examiner from errors into which he might otherwise fall. Additional care should be given to external marks or other features which may be useful for identification of the body, and it is best to make a note of these and of any external injuries before starting the examination of the internal organs. A great deal of time will be saved and embarrassment avoided if injuries both external and internal are carefully examined and accurately recorded. Any incisions made across injuries should be clean-cut so as to avoid the possibility of confusion with the original injury.

The stomach should be tied at its oesophageal end, and the intestine should be tied in two places near the duodeno-jejunal flexure and then divided between the ligatures; the rectal end should also be tied. Clamping off with Kocher forceps is quicker than tying and just as effective.

The genito-urinary organs, particularly in the female, often call for special examination, and here again it is important to make a careful inspection and to record the observations before cutting. If there is a question of damage to uterus or vagina, the pelvis should be raised on a wooden block, the legs separated, and with a good light directed on the perineum an incision made through the symphysis pubis and carried right round the vulva and anus, so that the labia and anal canal, vagina, rectum, and uterus may be removed intact without increasing any internal damage which may be present. The organs are then incised as previously described and carefully examined.

(5)—Infants and Children

Umbilical vein

The same general lines should be followed. The umbilicus, umbilical vein, and hypogastric arteries should be examined with particular care. It is advisable to open the umbilical vein as far as the hilum of the liver before removing the liver.

Ductus arteriosus

After the neck and chest organs have been removed the examination should be continued as for an adult. Before removing the heart, however, it is advisable to open the aorta from its lower end and to identify the ductus arteriosus, which passes from just beyond the beginning of the main left pulmonary artery to the aorta, into which it opens just beyond the arch. In infants slight constriction is normally present in that part of the aorta between the origin of the left subclavian artery and the ductus arteriosus.

Heart

Congenital abnormalities of the oesophagus and trachea should be looked for. In the heart deficiency of the pars membranacea septi and other abnormalities of the ventricles are liable to be missed unless looked for. The foramen ovale is more often patent than not and may be widely patent without having caused any inconvenience in life, provided that the membrane which should form the floor of the fossa ovalis is present and forms a valve.

Skull

In young infants and the newly born the brain must be removed by a special method. The scalp is reflected as in the adult. The superior sagittal sinus is next opened with scissors, and its contents are examined. An incision should then be made into the anterior fontanelle from 0·5 to 1 cm. to the right or left of the middle line. The opening should be sufficiently wide to admit one blade of a pair of scissors. Keeping about the same distance from the middle line and holding the scissors so as to damage the brain as little as possible (with a little practice the brain is undamaged) the operator makes an incision from this point to the lambdoidal suture. Another incision follows this suture to right or left, and a further incision follows the coronal suture of the same side. The incision in the anterior fontanelle is also carried forwards to separate the frontal bones. The parietal and frontal bones are next forcibly bent outwards. It sometimes helps to cut the bones part of the way with stout scissors at about the level of the petrous portion of the temporal bone. The hemispheres of the brain now tend to fall outwards. One of these should be separated from the rest of the brain by incising the corpus callosum and the crus, particular care being taken not to damage either the falx or the tentorium. The falx and tentorium are now carefully examined for haematomas or tears. A similar procedure is followed on the other side of the head, the tentorium and falx being again examined.

When the examinations have been completed, the tentorium may be incised near its attachment to the petrous portion of the temporal bone on each side, and the medulla and cerebellum may be removed. The under surface of the tentorium should now be examined, because sometimes damage is more obvious here than on the upper surface. Unless some such procedure is followed, it is impossible to demonstrate tentorial tears and haematomas which may be responsible either directly or indirectly for the death of the infant. This method also ensures the minimal handling of the brain and so produces less damage than any other method. The lateral sinuses and middle ears are next opened and examined as has been described for adults.

3.–CAUSES OF DEATH

1284.] Having made the examination the operator must attempt a reasonable explanation of his findings and be prepared to state the cause of death and to describe any lesions which contributed to it. For the commonest causes of sudden death see DEATH, SUDDEN AND UNEXPECTED, Vol. III, p. 565. A few conditions, however, are dealt with briefly in this article.

(1)—Wounds

Ante- or post-mortem

A wound involves a solution of the continuity of a tissue. It may be open or external when the skin is involved or internal when a subcutaneous tissue or organ is damaged beneath unbroken skin. If wounds are present, the first question to be decided is whether they were produced before or after death.

Reaction

Reaction of any kind, e.g. pus, scabs, and granulation tissue, in the borders of the wound can only be produced by the living body. Wounds causing immediate death, however, cannot be distinguished with absolute certainty from post-mortem wounds inflicted within two hours of death.

Information about the amount or the distribution of blood lost may

Amount of haemorrhage

make it clear whether the wound was inflicted before or after death. Blood may ooze from a post-mortem wound and drain from a dependent part. A considerable amount may drain away if the wound has severed a great vein, the blood has not yet clotted, and the body is in a suitable position. The blood tends to clot in the veins after death, and a number of factors play a part in accelerating or retarding the clotting; cold, for instance, may retard it for many hours. For this reason the longer the interval between the death and the wounding of a body the less the amount of blood that is likely to escape. As a rule large amounts of blood found in association with wounds suggest that the heart was still beating when the wound was suffered. If the blood has spurted, i.e. some of it has been found spattered over articles not in contact with the wound, it would suggest arterial bleeding and that the deceased was alive when wounded.

Clotting

Signs due to ante-mortem wound

A wound inflicted during life shows (i) haemorrhage, (ii) retraction of its edges, due to elasticity of living skin, subcutaneous tissues, and muscle, and (iii) signs of inflammation or repair. Wounds inflicted after death may or may not show (i), rarely (ii), and never (iii). A wound inflicted within two hours after death would show retraction of its edges, because the skin, subcutaneous tissues, and muscles are still capable of contraction. The weight of a limb may pull open a post-mortem wound, but the positions of the limb and of the wound would make it clear that there was no real retraction of the edges.

Types of wounds

A clean-cut wound is called an incised wound in contrast to a ragged or lacerated wound. A punctured wound is one in which there is deep penetration with comparatively small superficial damage. It is important to measure the depth of these wounds carefully, because the depth gives a clue to the length of the weapon used. If, however, the wound appears deeper than the length of a suspected weapon, it must not be immediately assumed that the wound was not caused by it. The penetration depends not only on the length of the weapon, but also on the violence of the blow and on the amount of 'give' in the tissue wounded. If there is much bruising of the tissues, the wound is said to be contused. A bruise is an effusion of blood into a tissue.

Causes of death

Wounds may have caused death directly if the deceased died immediately or very soon after being wounded, or indirectly if death occurred later from inflammation, septicaemia, or other disease which arose as a direct consequence of the wound. The direct causes are (i) loss of blood, (ii) injury to important organs, and (iii) shock. The indirect causes of death are (i) morbid changes arising in the wound, generally infection by micro-organisms, (ii) toxaemia, when a very large surface has been damaged, e.g. burns, (iii) disease following the injury, e.g. broncho-pneumonia, (iv) pre-existing disease (death may or may not have been accelerated by the wound), and (v) surgical operations and the administration of anaesthetics necessary for the treatment of the wound.

(2)—Asphyxia

Should the amount of oxygen reaching the blood or tissues of the body fall below the minimum necessary to maintain life, the death is described as being due to asphyxia. Apart from diseases, this manner of death is most often found in carbon monoxide and other gaseous poisoning and in death from suffocation, strangulation, and drowning.

General post-mortem appearances

Cyanosis is usually present, the extent varying from blue lips and finger tips to blue-black discoloration of face, neck, chest, and arms. When death has been caused by carbon monoxide poisoning, the colour is usually a bright red instead of blue, and this colour masks both ante- and post-mortem lividity. The blood remains fluid longer than usual and tends to be dammed up on the venous side, so that most of the viscera are engorged. If death is rapid, the lungs may show little change. If, however, partial obstruction to the bronchi has been present for some time, the lungs are emphysematous; and if the obstruction is complete, the lungs are collapsed, the extent of both the emphysema and the collapse corresponding to the anatomical distribution of the affected bronchus or bronchi. Petechial haemorrhages are common, particularly beneath the pericardium (especially over the coronary sulcus), in the thymus (especially in children), and in the pleurae. Petechial haemorrhages are seen as red dots varying in size from a pin point to a pin's head and are due to rupture of capillaries or minute veins, caused by raised blood-pressure or, in cases of disease or poison, by damage to the vessel wall.

Although these appearances are common in asphyxial deaths, none of them alone nor any combination of them provides conclusive evidence of asphyxia or indicates the cause of asphyxia. But, if no other lesions are present to account for them, they do afford very strong presumptive evidence and together with lesions suggesting strangulation, drowning, or other violence may form conclusive evidence of death from asphyxia.

Suffocation

Suffocation is a condition in which the free access of air to the lungs is impeded by mechanical means, e.g. access of air to the lungs may be prevented by mechanical blocking of the mouth and nostrils, by blocking the throat and air-passages, by compression of the chest, or by combinations of these. Violence involving constriction of the neck is a form of suffocation called strangulation. Drowning is a form of suffocation in which water or other fluid prevents access of air to the lungs.

Causes

The causes include (i) oedema of the glottis caused by disease, irritant substances or fumes, or scalding fluids; (ii) burying the face in soft substances, such as snow, mud, dust, or feathers; (iii) smothering, i.e. covering the face with soft clothing or pillows, overlaying, or close application of hand, cloth, or other material over mouth and nose with or without simultaneous compression of the chest; and (iv) foreign bodies in mouth, trachea, or bronchi.

In addition to the general appearances common to death from

Post-mortem appearances

asphyxia, the lungs may show acute alveolar and sometimes interstitial emphysema. Petechial haemorrhages are common and are often conspicuous in newly born babies and infants. Special care must be observed in examining the mouth, nose, and air-passages for foreign bodies of any kind and for oedema and signs of damage to the mucosa by irritating fluids or gases. Inhaled food in bronchi and bronchioles in infants is liable to be missed unless looked for with care.

Strangulation

External appearances

Strangulation may be defined as constriction of the neck by an act of violence. In a typical case the face is swollen and deep purple, the eyes are open and prominent, and the tongue is swollen, often protruding, and sometimes bitten; and usually a blood-stained froth exudes from mouth and nostrils. Rarely there is neither swelling nor lividity. There are usually marks of violence on the neck, and sometimes a cord or other substance is still tightly tied round it.

Internal appearances

Haemorrhage into muscles or connective tissues of the neck, fracture of the hyoid bone, or other evidence of violence may be found. The lungs are usually engorged, and petechial haemorrhages on the pleurae and pericardium are common. Venous engorgement of the other internal organs is common.

Hanging

Death due to fracture-dislocation of upper cervical vertebrae and damage to the spinal cord is mainly confined to judicial hanging. Apart from deaths of this kind hanging is a form of strangulation. It only differs from strangulation in that the body is suspended by the neck, and either the whole or the greater part of the body-weight provides the force which constricts the neck.

Drowning

In a typical case of death from drowning fluid is inhaled, and the bronchi and alveoli of the lung become filled with a mixture of fluid and air. The more dependent parts, usually the posterior parts and bases, contain most fluid, the anterior parts most air. When the chest is opened, the lungs appear distended, do not collapse, pit on pressure, and appear heavy and boggy, and on section frothy, sometimes blood-stained, fluid pours from the cut surface. Similar fluid to that found in the bronchi is often found in the stomach and less often in the intestines. Petechial haemorrhages in the serous surfaces are inconstant. Shock often plays an important part in killing a 'drowned' person; and since fluid is sucked into the lungs by the respiratory movements, it is obvious that, if death quickly follows the immersion, the amount of fluid found in the lungs may be very small. In fact all degrees are found between no fluid at all and the abundant fluid found in a typical case. If no fluid is found in the lungs, the death is not strictly due to drowning, and the most likely cause is shock, asphyxia due to inhalation of mud or other foreign matter, or some cause unconnected with immersion.

Medical drowning

In disease, death may be caused by an abnormal flow of fluid, blood, or pus into the air-passages. Blood from a burst aneurysm, pus from bronchi and bronchioles, and fluid from acute oedema may cause death from asphyxia, the individual drowning in his own fluids.

A special type of compression asphyxia, known as traumatic asphyxia, results from violent compression of the thorax or upper abdomen, or both. The characteristic lesion is a deep blue discoloration of the face and neck, the bluish background being studded with minute petechial haemorrhages, as is also the mucosa of the mouth. There are, as a rule, marked swelling and oedema of the tissues of the face and extensive subconjunctival haemorrhages. A number of thoracic and abdominal lesions, due to the crushing injury, may also be present.

Traumatic asphyxia

4.–BLOOD-STAINS

1285.] In the examination of stains suspected of being blood-stains three questions must be answered: (i) is the stain due to blood? (ii) was the blood human blood? and (iii) to which group does the blood belong?

Solution of stain

The first part of the examination consists in getting part of the stain into solution. If the stain is due to blood, immersion in cold water for twenty-four hours or less will bring blood pigments into solution, and the water will be coloured red, red brown, brown, or yellow. The solution is tested for peroxidase (with guaiacum, benzidine, or phenolphthalein) and haematin crystals and examined with a spectroscope. Another part of the stain is soaked in physiological saline in order to get a solution of the blood serum, and this is tested by the precipitin reaction, which shows whether the blood was human or not.

Only very fresh stains are worth examining for red blood-corpuscles.

If the stain is on cloth, a piece is cut off and put into cold water. If the stain is on the surface of hard material, such as a weapon or wood, a little is scraped off and put into water. The bulk of water should be small, just enough to allow free immersion and manipulation of the material. If the stain is recent, the water is soon coloured; if the stain is old, it may take twenty-four hours to soak out. Cold water is usually effective; if it is not, a saturated solution of borax or a dilute solution of ammonia may bring a refractory stain into solution.

Guaiacum test

The solution is tested by adding a few drops of freshly prepared tincture of guaiacum. If blood is present, a reddish-brown precipitate is formed. A little ozonic ether is then added, and, after mixing, the ether, on rising to the top, is coloured blue.

Benzidine test

The benzidine test is now more commonly used. A freshly prepared saturated (approximately 10 per cent) solution of benzidine in glacial acetic acid is made. From this a reagent which only lasts a few hours is made by adding twice the amount of 5 per cent w/v (20 volume) hydrogen peroxide solution. A scraping of the stain or a fragment of the cloth is placed on white filter paper; on adding a drop of reagent a blue colour immediately appears and radiates out into the filter paper if blood is present.

Crystals

A dry scraping of the stain is put on a microscope slide, a few drops are added of a solution of 0·1 per cent potassium chloride, potassium bromide, and potassium iodide in glacial acetic acid, and a cover-glass is put on. The slide is then heated over a low Bunsen flame until the fluid bubbles, and the slide is examined under a microscope. If blood is present, brown rhombic crystals of hydrochloride of haematin (haemin) appear.

Haemochromogen test

Scrapings or stains cut from material are put on a microscope slide and covered with two or three drops of Takayama's solution No. 2, i.e. 3 c.c. each of 10 per cent sodium hydroxide, pyridine, and saturated aqueous solution of glucose, these three added to 7 c.c. of distilled water. A cover-slip is put on and the specimen examined under a microscope. If blood is present, the colour changes through greenish-brown and dark red to pink, and then characteristic salmon-pink crystals of haemochromogen usually appear in 1 to 6 minutes. If the Takayama solution is freshly made, the crystals may not appear at once, and the slide should be heated till bubbles appear, when on cooling the crystals will be quickly formed. This method gives positive results with bloodstains heated to 150° C., washed in hot water, or contaminated with rust, and, according to Kerr and Mason, with stains up to 45 years old.

Spectroscopic examination

Oxyhaemoglobin, haemoglobin, methaemoglobin, haematin (alkaline and acid), haemochromogen (reduced alkaline haematin), and haematoporphyrin give characteristic absorption bands in a spectrum. The great advantage of this method of examination lies in the fact that these substances can be changed from one to another and that there are no other dyes or mixtures of fluids that can be made to do so.

Precipitin reaction to identify human blood

A fragment of the stained material or a scraping of the stained substance is put into physiological saline for twenty-four hours or more. It is essential that the solution should be clear; if it is not, part of it may become clear on standing, and this part should be removed with a pipette. If this does not occur, the solution must be filtered or if necessary centrifuged. When antiserum is added to the solution, a faint cloud appears at once at the points of contact and increases until there are a haze at the lower third of the column of fluid and a flocculent deposit at the bottom of the tube. The test may also be made in capillary tubes. A capillary tube is partly filled with solution and an equal amount of serum allowed to run in; at the junction of the two a white haze develops if the blood is human. The antiserum is obtained from a rabbit that has had three to five injections of human serum and has developed a high titre giving a quick reaction demonstrating human serum if present in a dilution of 1 in 1,000.

Blood groups

Stains of blood and other body-fluids, such as saliva and urine, often contain material giving the 'blood group' reactions. These tests will probably be of considerable assistance in medico-legal cases, and their application is now being extensively studied. It is important to realize their limitations. They may provide definite negative evidence. Seldom could they provide positive evidence. They are, however, useful in limiting a stain to a particular group. In clothing in particular, the fact that specific group characters are not peculiar to blood must be remembered, for clothes are especially liable to contamination by other secretions. Putrefaction also, according to some observers, may change the group specificity. (See also Vol. II, p. 532.)

5.–SEMINAL STAINS

1286.] If in a stain suspected of being seminal a single whole spermatozoon is identified, it is accepted as good evidence that the stain is in fact seminal. In the absence of such a finding it cannot be positively asserted that the stain is seminal.

Preparation of specimen

The stains to be examined are usually in materials of various sorts. The stained portion of material should be cut into small pieces. This should be done with the minimal amount of manipulation, and the piece of material should be handled as gently as possible. The pieces are placed in watch-glasses and covered, some by physiological saline, others by physiological saline and glycerin, and others by very dilute hydrochloric acid (one drop to a fluid ounce of distilled water). The purpose of the soaking is to free the spermatozoa from the threads of the material to which they have become adherent by congealed mucus and protein. They are very delicate and easily broken. After soaking for an hour one of the specimens may be examined. If spermatozoa are found, the stain is due to seminal fluid; if they are not found, the other specimens are allowed to continue soaking and are examined after two, four, and six hours.

Microscope slides

In order that the material may be examined with a microscope, a number of slides may be prepared in the following ways. A few threads of the soaked material may be carefully detached from the edge of the fragment and mounted on a slide. The fragment of material may be gently squeezed on the slide so as to leave a few drops of fluid. The surface of the soaked stain may be lightly scraped by one slide, which is then used to make a film on another. The piece of material may be squeezed, the fluid from it together with that in the watch-glass centrifuged, and the deposit used for making films. The slides should be examined fresh under an ordinary microscope and with dark-ground illumination. Some of them should be examined when dried and others after staining with methylene blue and eosin.

Test for crystals

A useful but non-specific test is to examine for the production of crystals by the addition of reagents. From the soaked material a drop of fluid is expressed on to a slide and, when it is nearly dry, a cover-glass is placed over it. A drop of aqueous solution of picric acid is placed on the slide close enough to the cover-glass to permit the solution to flow under this. The slide is immediately examined under the microscope, and, if positive, a crop of crystals are formed. When picric acid is used, the crystals are elongated, sharply pointed, and diamond-shaped. Another reagent which may be used is Florence's solution (potassium iodide 1·5 grams, iodine 2·5 grams, water to 30 c.c.). The positive tests are due to the presence of choline, a substance by no means limited to the cells found in seminal fluid. With Florence's reagent they are brown rhombic crystals rather like those of haematin, but they quickly become much bigger and then disappear.

Florence's solution

6.–INFANTICIDE

Definitions

1287.] Infanticide is murder of a new-born child. There is no clear definition of 'new-born'. The child must have begun an independent existence, but it is not clear how long after that it remains 'new-born'. In the vast majority of cases the injuries are inflicted at or within a few hours of birth. Since 1922 any woman causing the death of her newly born child by any wilful act or omission in circumstances which would have amounted to murder is found guilty of infanticide.

In the Infanticide Bill passed by the House of Lords on April 13th, 1938, it is provided that the Infanticide Act of 1922 be repealed. In the new Bill a recently born child is defined under the age of twelve months, and the circumstances in which the Bill applies to the mother are: '. . . the balance of her mind was disturbed by reason of her not having fully recovered from the effect of giving birth to the child or by reason of the effect of lactation consequent upon the birth of the child'. The Bill has not yet been before the House of Commons.

Accidental death

Causes of accidental death of a new-born child which may be confused with infanticide mainly arise because of the absence of skilled assistance. Such accidents include suffocation of the child by inhalation of liquor amnii, blood, urine, or other substances, and covering of the mouth or nose with clothes or foetal membranes. The cord may be torn by sudden expulsion of the child and cause death from haemorrhage, or it may be wound tightly round the child's neck and cause death by strangulation.

Methods used in infanticide

Some of these methods can be used in the wilful killing of an infant; those most commonly attempted are smothering with clothes, suffocation by the introduction of foreign bodies into mouth and throat, and cutting the cord and leaving it untied. The more violent methods include strangulation by ligatures round the neck and wounds of neck, head, or chest. The wounds may be incised, lacerated, or punctured. Punctured wounds are most commonly made in the region of the fontanelles, ear, eye, neck, or other parts of the head, over the spine, and over the heart. They are sometimes difficult to see externally, but the tracks they make are usually full of blood or clot and are obvious. Less violent procedures include exposure, starvation, poisoning, and drowning.

7.–IDENTIFICATION

Description of body

1288.] If the identity of the body is unknown, a careful description of it should be made. Particular attention should be given to general condition, height, weight, skin, hair, teeth, eyes, type of face, condition of hands and feet, birth marks, deformities, scars, and injuries.

Height and weight can be measured accurately. The skin may be dark, fair, or coloured; parts of it may be tattooed. The colour, texture, and amount of hair should be described. The number and condition of the teeth, and the colour, size, and general appearance of the eyes should be noted. The type of face, whether broad or thin, with high or low cheek bones, and the appearance, size, and shape of mouth, nose, and ears are important points in establishing identity. The condition of feet and hands may give a clue to employment or social standing. Birth marks, deformities, and scars help considerably to establish a doubtful identification.

When only portions of a body are found, a number of preliminary questions arise, such as the sex and probable age and height of the deceased, the date of death, and if it was natural. If a number of portions are found they should be fitted together if possible and an attempt made to reconstruct the body. In most cases clues will be found which will warrant answering the questions with assurance. When bones alone are found, it is often more difficult and in some cases impossible to answer all the questions.

8.–ESTIMATION OF LAPSE OF TIME SINCE DEATH

1289.] It is impossible to give hard and fast rules for estimating the time that has elapsed between death and the examination of the body. The post-mortem changes upon which such estimations are based are those of temperature of the body, rigidity of the muscles, colour and condition of the skin, general putrefaction in the organs, and contents of the stomach. The most important external conditions which determine the times at which the changes appear are heat, which accelerates, and cold, which retards most of them. If the body remains in water, this also will influence the changes. Internal conditions also play a part: putrefaction occurs early in bacteriaemias and intestinal obstruction, and rigor mortis appears unusually early in death associated with muscular exhaustion. For these reasons the following table can only be used as a rough guide.

External conditions

Internal conditions

POST-MORTEM CHANGES

Up to 12 hours	Body warm at first, becoming cooler later. Muscles flaccid. Rigor mortis later.
12 to 36 hours	Body cold. Some degree of rigor mortis present.
2 to 3 days	Greenish discoloration of skin of abdomen. Putrefaction begun.
3 to 8 days	Spread of discoloration of skin. Various degrees of distension of subcutaneous tissues of body cavities. Face swollen, tongue protrudes. Red lines and streaks extending down limbs.
8 days to 1 month	More extensive decomposition. Epidermis raised into blebs filled with thin red fluid. Body

	uniformly swollen. Eyelids, lips, nose, and cheeks swollen and discoloured, the features being no longer recognizable.
1 to 6 months	Continued decomposition. The wall of thorax and abdomen may become ruptured. Viscera become exposed.
6 months to 1 year	Softening of joints. Most of the viscera reduced to ill-defined pulp.
1 to 2 years	The tissues of the body dry, become shrunken, brown, and black. During this time crystalline deposits of phosphate of lime may be found on mucous membrane of stomach or surface of other viscera, and sometimes the greater part of the body may be saponified.

A largely digested meal in the stomach and upper intestinal tract suggests that it had been taken within the last four or five hours. The condition of the food in the stomach may suggest likely times of ingestion, but digestive processes may be inhibited by fear, excitement, or illness, so that a poorly digested meal may still be present in the stomach some hours after it would normally have been passed on into the intestine.

9.–PRESERVATION OF SPECIMENS FOR ANALYSIS FOR POISON

Labels

1290.] In preserving specimens for this purpose it is important to safeguard them from possible contamination. Should a charge of poisoning arise after the examination, it will be necessary at the trial to provide a detailed history of how the organs were removed from the body and what happened to them. It follows that they must only be allowed to come into contact with clean surfaces and to be put into clean jars, which must be sealed and carefully labelled. The label should bear clearly written in ink the date, the nature of the specimen, and the name of the deceased or some mark or number by which the specimen can be identified. Labels should be firmly attached to the jars.

Jars

Specimens should not be allowed to come into contact with each other and should therefore be put into separate jars. The jars should have wide mouths, and the fluid or specimen should fill the jar as completely as possible so as to reduce the liability to drying by evaporation. Glass-stoppered jars are commonly used, and a strip of adhesive tape fixed round the junction of stopper and jar can make the union air-tight. If poison is suspected from the beginning of the examination, the stomach (tied at both ends) with its contents can be put into one jar, the whole of the intestines (similarly tied) into a second, urine into a third, the liver or a portion of it, e.g. a quarter or a third, into a fourth, and half a kidney into a fifth. In poisoning with heavy metals, particularly lead, portions of bone, both long and flat, should be kept.

It is good practice to open all stomachs in a clean dish, so that in those cases in which poison was unsuspected but is suggested by the findings the contents of the stomach are properly preserved for analysis if required. This also applies to intestinal contents, but the intestine is usually one of the last organs to be opened and examined, and, if there is any suspicion of poison this will usually have arisen before the intestine has been opened.

On the completion of such an examination the coroner's officer usually takes charge of the specimens and delivers them in person to the laboratory of the analyst selected by the coroner to examine them.

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POST-PARTUM HAEMORRHAGE

See LABOUR, Vol. VII, p. 523

POTT'S DISEASE

See SPINE, DISEASES AND DEFORMITIES

PREGNANCY: NORMAL AND PATHOLOGICAL

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Reference may also be made to the following titles:

ABORTION
ANTENATAL CARE
FALLOPIAN TUBES DISEASES
LABOUR
PLACENTA, DEVELOPMENT AND DISEASES
PYELITIS

1.–PHYSIOLOGY

(1)—Placentation

1291.] This is discussed under the title Placenta, Development and Diseases, Vol. IX, p. 641.

(2)—Changes in the Maternal Organs during Pregnancy

Uterus

During pregnancy the uterus increases enormously in both size and weight. The virgin uterus measures about 2½ inches long and 1½ inches wide and weighs about 2 ounces. At term the pregnant uterus measures from 12 to 15 inches in length, is about 9 inches wide at its widest part, and weighs—apart from its contents—about 2½ pounds. This enlargement is due chiefly to hypertrophy of existing muscle-fibres, which increase both in length and in thickness, but partly to formation of new ones. The connective and elastic tissues also undergo hyperplasia. *Measurements*

The uterus at the same time becomes more vascular by dilatation of existing blood-vessels, especially the veins. There is no evidence of the formation of new vessels. Underneath the placental site the dilated veins open into the large decidual sinuses, which receive the blood from the choriodecidual space.

It is believed that these changes in the uterus are due chiefly to the hormone oestrin. In the early months of pregnancy these changes result in considerable thickening of the uterine wall, but from about the fifth month onwards the uterus becomes more and more distended by the enlarging foetus, and in consequence the walls become progressively thinner, so that at term they are generally not more than ¼ to ½ inch thick.

Shape The shape of the uterus, too, undergoes characteristic changes. The virgin uterus is pear-shaped; by the end of the third month it has become globular or almost spherical; from then onwards, as the length of the uterus increases more rapidly than its breadth, it again becomes pyriform and remains so till term.

Muscle layers The muscle-fibres in the pregnant uterus at term are arranged in three more or less distinct layers: (i) a thin layer of longitudinal muscle immediately underneath the peritoneum and passing antero-posteriorly over the fundus; muscle-fibres from this layer pass into the various supporting ligaments of the uterus; (ii) the inner layer, also thin, mainly circular, and specially developed round the openings of the uterine (Fallopian) tubes and the internal os; and (iii) the middle layer forming the main thickness of the uterine wall. The fibres composing it are arranged in the form of figures of 8 round the blood-vessels and thus exercise an important influence in controlling haemorrhage during and after the third stage of labour.

Cervix uteri The cervix, like the uterus, becomes much more vascular in pregnancy, and in consequence the portio vaginalis undergoes a characteristic softening and violet discoloration, both of which are useful signs of pregnancy. The mucous membrane of the cervix also becomes much thickened, and the glands become excessively dilated and penetrate deeper than usual into the fibromuscular stroma. The glands secrete very actively and produce the mucous plug which fills the cervix and shuts off the vagina from the interior of the uterus.

Tubes and ovaries

The tubes in pregnancy undergo little change apart from increased vascularity; as the fundus rises into the abdomen, their axes become almost vertical.

The ovaries also become more vascular and usually appear larger than in the non-pregnant state and characteristically elongated. The corpus luteum continues to enlarge till the end of the third month, when it measures about 1 inch in diameter and projects on the surface. From this time it undergoes gradual atrophy and at term may be barely visible to the naked eye.

Corpus luteum

Ovulation usually ceases in pregnancy, but follicles still undergo partial development followed by atresia. In the theca interna of the atretic follicle there is a large development of theca or paralutein cells, very much as occurs in the ovary of the child. These cells may invade the stroma and give to the ovary in pregnancy a very characteristic appearance. Their function, if any, is unknown.

Ovulation

Vagina

Increased vascularity is the main feature and accounts for the characteristic violet discoloration of the mucous membrane and increased moisture. The muscle hypertrophies and the connective tissue becomes loosened; probably these changes tend to make the vagina more dilatable during labour.

Abdominal wall

As the uterus enlarges, the abdominal wall becomes stretched. In consequence the recti abdominis muscles tend to become separated from each other in the middle line. The extent of this divarication varies considerably and is usually much more conspicuous in multiparae than in primigravidae. The rapid stretching of the subcutaneous tissues results in the formation of the striae gravidarum in the later months of pregnancy, pink slightly depressed linear areas on the abdomen, especially below the umbilicus. Histologically the elastic fibres of the cutis are torn asunder, so that they are entirely absent underneath the striae but heaped up at the sides. Factors favouring the production of striae are great and especially rapid increase in size of the uterus, so that they are more likely to be prominent if the child is large, or if there is hydramnios or multiple pregnancy. They rarely appear before the fifth month, and after pregnancy lose their pink colour, become pale and silvery, and persist as lineae albicantes. In about 20 per cent of cases they are entirely absent.

Striae gravidarum

Lineae albicantes

Another characteristic change is a dark pigmented streak in the middle line of the abdomen, the linea nigra. It is usually, but not always, more conspicuous in women of dark complexion.

Linea nigra

Breasts

With the onset of pregnancy the breasts become more vascular; this results in the appearance of blue veins under the skin. In most women one of the earliest manifestations of pregnancy is a pricking sensation, doubtless due to increase in vascularity and soon followed by a feeling of fullness, which is most marked in primigravidae. About the end of the third month the nipple and its immediate surroundings are more deeply pigmented than normal, and on the pigmented area round the nipple Montgomery's tubercles, about 6 to 15 in number, are seen; these are the mouths of sebaceous areolar glands which, though present in the virgin, have become hypertrophied and conspicuous. About the end of the third month also a little watery fluid can be expressed from the nipple. Enlargement of the breast becomes appreciable by the fourth month and continues to progress till term. Probably on account of the rapid stretching of the skin, striae often appear on the breasts similar to those on the abdominal wall.

Montgomery's tubercles

Enlargement

Striae

The most important functional change in the breast takes place in the parenchyma. The alveoli enlarge and the lining cells undergo rapid proliferation. There occurs in addition marked sprouting of the tubules, which become finer as they pass away from the main ducts. The new tubules are at first solid cords but become canalized during the second half of pregnancy. Each tubule terminates in an alveolus.

Changes in parenchyma

New tubules

The circulatory system

The heart tends to be displaced by the upward growing uterus especially in the later months, so that the apex beat lies at a slightly higher level and further out, i.e. in the fourth interspace and 1 inch outside the nipple line. Recent investigations confirm the view that the heart undergoes a work hypertrophy. Radiographs show an increase in both the longitudinal and transverse diameters even as early as the fourth month. As the lungs, especially their bases, are compressed, respiration tends to be shallow and imperfect, and this causes embarrassment of the pulmonary circulation and consequently to some extent of the right ventricle. At the same time more work is required of the heart in consequence of (i) the increased weight of the pregnant uterus and the size of its vascular bed, and (ii) the increase in the minute-volume, i.e. the quantity of blood passing through the heart per minute, on account of the rise in blood-volume. The minute-volume increases steadily till the thirty-seventh week, when it may be as much as 60 per cent greater than before pregnancy. There is general agreement that the blood-volume increases during pregnancy, and that the increase is relatively greater in the plasma than in the corpuscular elements, so that there is some hydraemia. This hydraemia is one of the reasons commonly adduced to explain the physiological anaemia that can be demonstrated from the end of the second month onwards. A second factor in the causation of this anaemia is probably the demand of the foetus for iron. The sedimentation rate of the blood is increased, and there is a definite rise in the fibrinogen and cholesterol content. There is not any evidence that the blood-pressure is raised in normal pregnancy.

Displacement of apex beat

Work hypertrophy

Increase in blood

Physiological anaemia

Blood-pressure

The respiratory system

The upward displacement of the diaphragm in the last three months of pregnancy tends to embarrass respiration, but this is compensated by the widening of the lower part of the thorax, the circumference of which may measure from 2 to 6 inches more than in the non-pregnant state. *Hoarseness* Hoarseness is not uncommon in pregnancy and results from oedema and swelling, sometimes accompanied by the presence of decidual cells, in the false vocal cords.

Alimentary system

Constipation Constipation is exceedingly common, especially in primigravidae. It is in all probability due to two factors: (i) too little exercise, and (ii) atonicity of the wall of the bowel, which appears to be desensitized by the corpus luteum hormone.

Morning sickness and heartburn Other troublesome disorders that may occur are morning sickness and gastric acidity (heartburn). *Achlorhydria* Achlorhydria is very common, but its cause is unknown. It is believed to be an important factor in predisposing to anaemia. *Liver glycogen* The glycogen content of the liver is diminished, and possibly this is one reason why the liver is so sensitive to the action of poisons such as chloroform (see Acute Yellow Atrophy, p. 105).

Teeth The teeth of pregnant women tend to become soft (see p. 107).

Urinary system

Frequency of micturition The softness of the walls of the uterus early in pregnancy and at a time when the ovum does not fill the entire cavity often results in exaggerated anteflexion, so that the fundus falls forwards on to the bladder. This may result in frequency of micturition, which disappears after the twelfth week.

Stasis of urine The ureters and renal pelves, especially on the right side, tend to become dilated, with stasis of urine. It is believed that a chief cause of this is the loss of tone in the ureters that begins very early in pregnancy and is probably due to desensitization of unstriped muscle by corpus luteum hormone. Another cause is that the uterus often exerts pressure on the right ureter at the pelvic brim, partly because (for various reasons discussed on p. 416) the right ureter is peculiarly exposed to pressure and partly because the pregnant uterus tends to lie somewhat over towards the right side. According to Hofbauer there is also hyperplasia of the muscle and connective tissue of the ureters at their entrance into the bladder. This stasis, however caused, predisposes to pyelitis.

The skeletal system

Osteomalacia As in the case of the teeth, the calls of the foetus for calcium may deplete the mother's stores in her skeletal system, leading to various degrees of osteomalacia. Well developed osteomalacia is not uncommon in India and China (see Vol. VII, p. 571). Although advanced degrees of this disease are rare in Europe and America, minor manifestations, e.g. pain in bones and joints, sleeplessness, and violent movements of the foetus, are probably not uncommon.

The joints of the pelvis become much more movable in pregnancy from softening of the ligaments and cartilages, probably caused by a specific hormone. *Changes in pelvis*

Nervous system

Minor nervous symptoms, such as irritability of temper, emotional disturbances, and sleeplessness, are not uncommon. The vomiting of pregnancy is often considered to have a neurotic basis, but this is by no means certain. Serious nervous disturbances, such as insanity, are fortunately very rare.

Increased sensitivity of nervous system

The nervous system appears to be, even in normal pregnancy, definitely more irritable. Thus a smaller dose of camphor monobromide will cause convulsions in a pregnant cat than in a cat that is not pregnant, and creatin applied to the cerebral cortex or injected into pregnant animals also causes convulsions, a result rarely obtained in non-pregnant animals.

Integumentary system

Pigmentation

Pigmentation of the skin at certain areas is practically always present in some degree. For the linea nigra on the abdomen and the dark pigmentation of the nipples and areolae see pp. 52 and 53. A particularly distressing form of pigmentation is the chloasma, a diffuse or circumscribed yellowish or bronze pigmentation of the face, which sometimes resembles a mask. Fortunately, although the pigmentation of the nipples and breasts tends to persist to some extent, the chloasma almost always disappears completely shortly after pregnancy is over. These pigmentation changes may be due either to expansion of the melanophores or pigment-bearing cells of the skin by a hormone (intermedin) derived from the pars intermedia of the pituitary, or they may be connected with the adrenal changes. *Chloasma*

The ductless glands

There is no doubt that profound changes with bearings of the first importance upon the entire metabolism occur in pregnancy, but histologically, and much more in their biochemical aspects, they have been as yet insufficiently studied.

Thyroid

Chief among them are the changes in the thyroid. There is general agreement that enlargement of the gland is normal in pregnancy. Lange found that it was visibly enlarged in 108 of 133 pregnant women, and that of the 25 others 18 developed severe albuminuria. The enlargement is diffuse; it is a true hyperplasia comparable with that which occurs at puberty and menstruation, and it is associated with increased functional activity. It first becomes noticeable about the fourth month and the increase continues till delivery. In the puerperium it gradually diminishes, and by the fourteenth day the size has usually returned to normal. Possibly some of the nervous symptoms (irritability, insomnia) met with in pregnancy are due to slight hyperfunction. The significance of the hyperplasia of the gland is unknown, but it apparently accounts for the increase in the basal metabolic rate, which by the end of pregnancy is about 20 to 25 per cent above normal. *Rise in basal metabolism*

Parathyroids

The parathyroids also undergo considerable hypertrophy. They are apparently concerned with the maintenance of the normal calcium level of the blood of the mother at about 10 mgm. per 100 c.c. of serum, and this they accomplish by decalcifying, if necessary, the mother's bones and teeth.

Anterior pituitary

The anterior pituitary undergoes great hypertrophy in pregnancy, sometimes to twice its usual size. The hypertrophy is largely due to increase in number and size of the so-called 'pregnancy cells'.

Posterior pituitary

The posterior pituitary does not undergo any appreciable hypertrophy.

Adrenal gland

The cortex of the adrenal, chiefly the zona fasciculata, also hypertrophies. Little is known of its significance, but it is generally believed to be concerned with the increase in the cholesterol content of the blood referred to on page 57.

(3)—Metabolic Changes

Gain in weight

Most pregnant women experience a feeling of increased well-being, especially in the last six months, accompanied by a gain in weight, not all of which can be accounted for by the uterus and the growing ovum. Thus Cummings found that the total average gain in 1,000 women was 24·08 pounds, the average monthly weight changes being as follows: 0, 1, 1, 4, 4, 5, 5, 3, 3 pounds; about 40 per cent showed a loss of 1 to 3 pounds in the two weeks preceding labour. Not more than half of this gain in weight can be accounted for by the growth of the uterus, breasts, and ovum (including the placenta and liquor amnii), so that there must be a considerable addition to the mother's own tissues.

Nitrogen storage

Metabolic studies of nitrogen balance during pregnancy have shown conclusively that nitrogen is stored, especially during the last six months of pregnancy, far in excess of the needs of the developing ovum.

From observations on nitrogen intake and output in one woman during the last twenty-four weeks of pregnancy, Hoffström (1910) found that there was a total nitrogen storage of 310 grams, representing over 2,000 grams of protein. He estimated that only about one-third of this was required by the developing foetus, the balance being somehow stored by the mother for her own use, probably a reserve to meet the needs of labour and the puerperium.

Non-protein nitrogen of blood

Most observers agree that during pregnancy there is a slight decrease in the non-protein nitrogen of the blood.

Cadden and Faris estimated it in 132 women and concluded that it decreased in the first six lunar months, from an average non-pregnant value of 30, to 24 mgm. per 100 c.c., and that in the last four lunar months it increased steadily till one week post partum, when it averaged 33 mgm. per 100 c.c.

Urea nitrogen

The urea nitrogen was found to diminish in the first six lunar months, from the usual non-pregnant value of 14 mgm. to 6 mgm. per 100 c.c., at which level it remains till the eighth and ninth months, when it again begins to rise and has an average value of 7·12 mgm. at term and 11 mgm. on the eighth day post partum. The ratio of the urea nitrogen to non-protein nitrogen is lowered, from a non-pregnant level of approximately 0·50, to 0·25 in the sixth or seventh month and 0·27 at term.

Carbohydrate metabolism

Carbohydrate metabolism is considerably disturbed. The capacity for storing and utilizing sugar is diminished, so that a physiological glycosuria is common. The cause of this is not known, but it may be due to the hypertrophy of the adrenals or the changes in the pituitary. Because of the poor utilization of carbohydrate fat metabolism is imperfect, and intermediate products of fat metabolism (e.g. acetone, acetoacetic acid) may appear in the blood in excess and in the urine, even in normal pregnancy.

Fat metabolism

In the latter half of pregnancy fat, lecithin, and cholesterol in the blood are considerably increased, the blood fat by as much as 50 per cent, probably a preparation for lactation. The significance of the cholesterol increase is unknown.

Blood calcium

The blood calcium is slightly but definitely lowered in the last half of pregnancy, probably on account of the drain by the foetus. It has been estimated that from 1·6 to 1·7 grams of calcium and 1·8 to 2 grams of phosphorus in the food daily are necessary to meet the needs of the foetus and to prevent a deficiency of these substances in the mother.

Iron

The foetus obtains iron, probably from the mother's haemoglobin, to build up its own red blood-corpuscles and nucleoprotein. In the last two months the iron content of the foetus increases from 80 to 400 mgm., which amounts to a storage of 5 mgm. daily. The storage takes place chiefly in the liver, which, weight for weight, contains at term five times as much iron as that of the adult. In order to prevent a deficiency in the mother and consequent anaemia, at least 20 mgm. daily is necessary, especially in the last three months of pregnancy, when the demands of the foetus are highest.

(4)—Hormones in Pregnancy

Progestin or progesterone

Site of production

Physiological action

This is produced by the corpus luteum and apparently by the placenta. The following effects are attributed to it: (i) the development of the premenstrual endometrium (thus completing the building up of the endometrium that has been carried to a certain point by oestrin), and its preparation for embedding of the fertilized ovum; (ii) the maintenance of pregnancy, as shown by the experiments of Fraenkel and Cohn on rabbits; it is presumed that progestin, whether produced by the corpus luteum or by the placenta, is likewise essential in the human female, and on this assumption is based the modern treatment of habitual or threatened abortion by progestin or progesterone; (iii) desensitization of the uterus and diminution of its power of contraction; Knaus is chiefly responsible for this view, but it is contradicted in so far as humans are concerned by Chassar Moir and more recently by Kurzrok; if the views of Knaus are correct, this action may be important in maintaining pregnancy by calming down uterine contractions, and this might be another reason for administering progesterone in threatened or habitual abortion; (iv) the growth of the lobules of the breast (see p. 53); and (v) the inhibition of ovulation during pregnancy.

Oestrin

Site of production

This is a collective term applied to the follicular hormone produced by the developing Graafian follicle and later also by the corpus luteum and the placenta. It is known by various names, such as female sex hormone, folliculin, follicular hormone, and theelin. The hormone derived from the ovarian follicle is often now called oestradiol, whereas oestrone is the excretion product found in the urine. These two have similar but not quite identical properties.

Physiological ıction

The functions of oestrin in pregnancy are believed to be as follows: (i) the stimulation of the endometrium to regenerate after it has been cast off during menstruation, and, after repair is complete, development of the endometrium till the start of the premenstrual phase, and preparation of it for the embedding of the ovum; (ii) the production of hyperplasia of the uterus and other generative organs in pregnancy; (iii) the formation of the pregnancy cells in the pituitary; (iv) the sensitization of the uterine muscle to pituitary secretion, so that its contractions are more powerful; this sensitivity increases towards term and may be an important factor in the onset and proper termination of labour; (v) the stimulation of growth of the mammary ducts, little or no effect, however, being produced on the lobules; and (vi) the inhibition of the secretion of prolactin by the anterior pituitary, so that milk secretion is prevented till the placenta, which is the main source of oestrin in pregnancy, is born.

The amount of oestrin in the blood and urine increases steadily throughout pregnancy and drops rapidly after delivery. This is difficult to explain, because the chorionic epithelium, on which the production of oestrin presumably depends, becomes more and more atrophic as term approaches.

Gonadotropic hormones

Site of production

These comprise the two hormones, prolan A, the follicle stimulating, and prolan B, the luteinizing hormone. They are produced by the anterior pituitary, but most observers believe that they are also produced by the placenta. The hormones are obtained in large quantities from pregnancy urine; this forms the basis of the Aschheim-Zondek test for pregnancy (see p. 62). The amount excreted in the urine is much greater in the early months than later, and towards term there may be very little (Boycott and Rowlands). In hydatidiform mole and chorionepithelioma the hormonal excretion in the urine is much greater than normal, and this fact is made use of clinically in the diagnosis of these conditions (see Vol. III, pp. 218 and 223).

Physiological action

Very little is known of the action of these hormones in pregnancy. It may be that they are concerned with the production of the theca or paralutein cells (interstitial cells) in the ovary.

Prolactin

This hormone, also produced by the anterior pituitary, is responsible for the secretion of milk. During pregnancy its production is inhibited by oestrin, but when, after the birth of the placenta, the supply of oestrin suddenly drops prolactin is released.

Relaxin

This hormone is obtained from the corpus luteum, but whether it is the same substance as progestin is not known. It is apparently responsible for the softening and relaxation of the pelvic joints in pregnancy.

Posterior pituitary extract

See PITUITARY GLAND DISEASES, Vol. IX, p. 613.

2.—DIAGNOSIS OF PREGNANCY

1292.] The diagnosis of pregnancy is usually easy, but it may, especially in the early stages, present considerable difficulty.

(1)—Signs

Amenorrhoea

Amenorrhoea is usually the earliest sign. The sudden cessation of previously regular periods is strong evidence of pregnancy. Nevertheless, there are certain well known fallacies; amenorrhoea may be due to other conditions, such as tuberculosis, endocrine abnormalities, change of climate, and various emotional disturbances (see Vol. I, p. 360).

Breast signs

The feeling of fullness in the breasts or the sensation of pricking, described on page 52, is often, especially in a primigravida, a very early sign; not uncommonly it even precedes amenorrhoea. Many women, however, experience similar sensations just before a menstrual period. The other changes in the breast are described on page 52. Pigmentation of the areola is not caused by any other condition than pregnancy and, if definite, is therefore diagnostic. A slight watery secretion, however, can occasionally be expressed from the nipple in some other conditions, such as uterine fibroids and ovarian tumours, or even in the absence of any apparent morbid condition. After the fourth or fifth month the enlargement of the breasts, perhaps the appearance of striae, the marked pigmentation, and the ease with which secretion can be expressed leave, as a rule, little doubt about pregnancy. In multiparae breast signs are as a rule of far less value, especially as some pigmentation and secretion in the nipples have remained from previous pregnancies.

Morning sickness

A feeling of nausea or actual vomiting on getting up in the morning is experienced by about 50 per cent of pregnant women. As a rule it begins two or three weeks after the patient has noticed the absence of a period and continues till about the end of the third month, when it gradually subsides. Sometimes, however, it may be the first indication of pregnancy, even preceding amenorrhoea. Morning sickness may be caused by gastritis and may appear in women who fear pregnancy or greatly desire it and think they are pregnant when they are not (pseudo-cyesis).

Pseudo-cyesis

Vulval signs

The increased vascularity of the mucous membrane of the vulva causes a characteristic bluish or purple discoloration, which is easily seen on separation of the labia. The mucous membrane also looks more turgid, and secretion appears to be increased. On introduction of the finger the vagina gives the impression of being more moist and succulent and of slightly increased warmth.

Cervix

The softening of the cervix is, when well marked, as in the late months, very characteristic and of great value in diagnosis. It may be detected, however, as early as the sixth or eighth week and by the end of the third month is usually very evident. Erosion of the cervix may give a somewhat similar feeling. Passage of a speculum will reveal the erosion.

Uterus

Bimanual examination of the uterus in early pregnancy reveals some very characteristic signs. Enlargement may be detected or at least suspected from the sixth week onwards, and at the same time the organ may be more globular, bulging antero-posteriorly and laterally. The consistence, too, has changed; instead of being firm it has become softer and has even acquired a slightly cystic feel. All these signs, however, may be very indefinite during the first six or eight weeks, especially in the multipara whose uterus has remained somewhat enlarged and perhaps of more soft consistence after previous pregnancies.

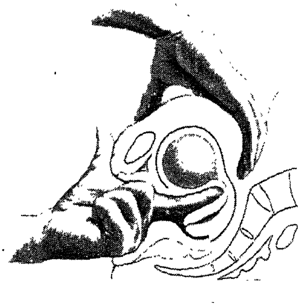

FIG. 1.—Hegar's sign of early pregnancy. This and Figs. 3 to 6 and 8 to 10 from *Grundriss zum Studium der Geburtshülfe*, by E. Bumm

Hegar's sign

Great importance is therefore attached to Hegar's sign, which is positive from the sixth till the end of the tenth week. This sign depends on the softening of the isthmus at a period when the ovum does not as yet completely fill the uterine cavity, and when the soft and empty isthmus can therefore be easily compressed into a seemingly thin sheet of tissue between the fingers of the external and internal examining hands (see Fig. 1).

To elicit it the patient should be in the dorsal position with the knees well drawn up so as to relax the abdominal muscles as much as possible. One or two fingers are placed in the anterior fornix, while the fingers of the external hand are placed on the abdomen behind the isthmus of the uterus. The tips of the fingers of both hands are now pressed gently and firmly together as if trying to make the fingers of the two hands meet. In pregnancy the two hands seem about to meet, so thin do the tissues between them appear to be. This is one of the most valuable signs of early intra-uterine pregnancy and is not found in any other condition. The examination should be carried out very gently, lest it produce abortion.

Abdominal enlargement

The fundus uteri, as it rises above the pelvic brim, is usually palpable above the symphysis pubis by the end of the twelfth week. The abdomen becomes visibly enlarged about the fifth month. The swelling of the abdomen caused by the pregnant uterus is central, symmetrical, of smooth and regular outline, and of firm yet soft consistence—characteristics which may help to distinguish it from swellings caused by pathological tumours.

Braxton Hicks sign Intermittent contractions of the uterus were first described by Braxton Hicks in 1872; this sign is therefore known as the 'Braxton Hicks sign'. It consists in the presence of intermittent rhythmical contractions that are usually easily detected by the hands laid on the abdominal wall over the uterus. The contractions are present in the non-pregnant uterus, but in pregnancy they become much more obvious and can be detected clinically as early as the fourth month. As term approaches, they are more easily elicited and are more frequent and prolonged, so that the resulting hardness of the uterus may interfere considerably with abdominal palpation. Very similar contractions may be evident in a uterus containing a soft rapidly growing fibroid.

Quickening Foetal movements are generally first felt by the mother about the sixteenth to the eighteenth week. The sensation may be simulated by intestinal peristalsis, and for this reason, and because the sign is purely subjective, it cannot be relied upon as evidence of pregnancy. Sterile women who much desire a child not uncommonly persist in stating that they feel movements, even though they are repeatedly told that they are not pregnant. On the other hand, it may be possible to detect foetal movements by palpation in a patient who denies that she is pregnant.

Uterine souffle The uterine souffle is a soft blowing sound synchronous with the mother's pulse and probably due to the passage of blood from the uterine arteries into the placental sinuses. It has been aptly compared to the puffing of the engine of a goods train steaming uphill. It is not always present in pregnancy and may occasionally be heard over a soft rapidly growing large fibroid. It may also be detected for some time after intra-uterine death of the foetus.

Foetal heart sounds Foetal heart sounds can usually be heard about the twentieth week, seldom earlier. At first they are most likely to be heard on auscultation in the middle line below the umbilicus, but later their point of maximal intensity depends on the presentation and position of the foetus.

Funic souffle The funic souffle is a soft blowing sound synchronous with the foetal heart sounds and probably due to slight compression of the umbilical cord between the body of the foetus and the wall of the uterus. It is but rarely heard and may be present at one time and absent at another, so that it is of little assistance in the diagnosis of pregnancy.

Foetal parts The foetal parts may be felt, especially if the abdominal wall is thin, as early as the sixteenth week. At this early period they are best detected by external and internal ballottement. *External ballottement* External ballottement is elicited by palpating the uterus externally with the fingers, until what appears to be a part of the foetus is felt. If the part is then sharply tapped by the tip of the forefinger it can be felt to float away and then quickly back again against the finger. *Internal ballottement* Internal ballottement can be elicited in the same way but with the finger in the anterior, posterior, or lateral fornix. The most typical sensation is felt when the foetal head is thus palpated, because it is so movable on the neck. The sign depends on the fact that early in pregnancy the quantity of liquor amnii relative to the foetus is large, so that the foetus can easily be made to float freely about. In more advanced pregnancy the sign is more difficult to demonstrate, the foetus being less mobile. Ballottement is a most valuable sign of pregnancy, though it is conceivable that it might be simulated in certain conditions, such as a small solid ovarian tumour floating in ascitic fluid. In the later months, i.e. from the sixth onwards, foetal parts, especially the limbs, can usually be palpated easily; this forms the basis of the various methods of diagnosing the presentation and position of the foetus by abdominal palpation (see also Vol. VII, p. 436).

Pigmentation The importance of breast pigmentation has already been referred to (see p. 59). Abdominal pigmentation (linea nigra) is much less important, because it appears later, about the fifth month, and therefore at a time when the diagnosis of pregnancy is usually not in much doubt. In many women, especially those of fair complexion, it may be very little marked even in advanced pregnancy.

Striae gravidarum Striae gravidarum (see p. 52) appear on the abdomen about the end of the fifth month and become more conspicuous towards term. Although striae strongly suggest pregnancy, in about 20 per cent of pregnant women they are absent, and they may occasionally be caused apart from pregnancy by ascites, deposition of abdominal fat, the growth of an abdominal tumour, and any other conditions that cause rapid stretching of the abdominal skin.

Radiography Although an ossific centre appears in the clavicle as early as the seventh week, X-rays are of no value in the diagnosis of pregnancy till the fourteenth week. Even then good radiographs are not easily obtained on account of the frequent movements of the foetus and their wide range. They are of very great assistance, however, in such conditions as suspected hydatidiform mole and pregnancy with fibroids and in the detection of foetal death, malformations, and foetal deformities. (See also Vol. VII, p. 588.)

Absolute and presumptive signs Of all the signs of pregnancy discussed above only three, the foetal heart sounds, palpable foetal parts, and the evidence derived from radiography, certainly indicate pregnancy. They may therefore be called 'absolute signs'. All the others, singly or grouped together, may lead to a strong presumption of pregnancy, but not amounting to a certainty. They are therefore known as the 'presumptive signs'.

(2)—Aschheim-Zondek and Friedman Tests

Aschheim-Zondek test

Basis of test This test depends on the presence in the urine of the pregnant woman of an anterior-pituitary-like substance which, injected into immature mice, produces a characteristic reaction with the formation of haemorrhagic corpora lutea in the ovaries.

Technique The test is carried out as follows: five female mice three to four weeks old and weighing 6 to 8 grams each are injected subcutaneously (usually in the buttock) twice daily for three days with slightly acidified morning urine. The urine need not be sterile. The quantities injected are as follows:

Mouse 1 . . . 0·2 c.c. at each injection
" 2 . . . 0·25 " " "
" 3 . . . 0·3 " " "
" 4 . . . 0·3 " " "
" 5 . . . 0·4 " " "

Interpretation of results

The mice are killed at the end of 100 hours and the ovaries inspected. The presence of one blood point (easily visible to the naked eye and about the size of the head of a small pin) is sufficient for diagnosis.

Positive reactions

Reaction i

Reaction ii

Reaction iii

If the test is positive, one of three reactions may be observed in the ovaries, known as reactions i, ii, and iii. In reaction i the ovaries are slightly enlarged, pinkish, and often on naked-eye examination enlarged follicles may be seen. On microscopical examination enlarged follicles with theca and cumulus oophorus are seen. This reaction is not diagnostic of pregnancy but may be met with in myoma, after castration, at the menopause, in carcinoma of the genital organs, and in endocrine disturbances, e.g. hyperthyroidism. In reactions ii and iii the ovaries are enlarged and congested. Reaction ii is indicated by the presence of one or more blood points on the surface of the ovary, and microscopically by massive bleeding into enlarged follicles. Reaction iii is indicated by the presence of corpora lutea.

Percentage accuracy

Reactions ii and iii are the only ones diagnostic of pregnancy. They can usually be recognized by simple naked-eye inspection of the ovaries or with the aid of a hand lens. Very rarely microscopical examination is necessary. The test is correct in 98 to 100 per cent of cases. It seems to depend on the presence of living chorionic epithelium and may therefore be used as a test for death of the foetus in cases in which pregnancy is known to exist. Since, however, the chorionic epithelium survives for some time after death of the foetus, the test does not become negative for eight to twelve days after foetal death has occurred; but if there has been gradual interference with the placental circulation prior to its complete cessation, such as occurs in placental infarction, it may become negative in three days.

Since the Aschheim-Zondek reaction becomes positive three to five days after the first period is missed, it can be obtained at a time when by no other means could the fact of pregnancy be established with certainty.

Friedman test

This is a more rapid test for pregnancy than the Aschheim-Zondek reaction and gives equally reliable results. It has also the advantage that rabbits are used, because they are more easily obtained than mice and are less likely to die as a result of the injections.

Technique

The technique is as follows: a virgin rabbit is used which must not be less than twelve weeks old. Two intravenous injections are given (into an ear vein), each of 6 c.c. of morning urine, not necessarily sterile, daily for 2 days, i.e. four injections in all, and forty-eight hours after the first injection the animal is killed and the ovaries are inspected. Corpora haemorrhagica, which are easily seen projecting on the surface of the ovary by the naked eye and are much larger than the blood points seen in the mouse test, indicate pregnancy (see Fig. 2).

It is important to be certain that ovulation has not taken place recently before the test is done (ovulation in the rabbit depends on copulation and takes place in eight to ten hours after it), and that the rabbit is not pregnant. Therefore the rabbits used should be isolated for at least thirty days. It is also recommended that each rabbit should be isolated to avoid the possibility of pseudo-ovulation. In this condition the follicle develops to some extent, and haemorrhage occurs into it, but the follicle, though visible on the surface, is much smaller than in the positive test above described and does not rupture.

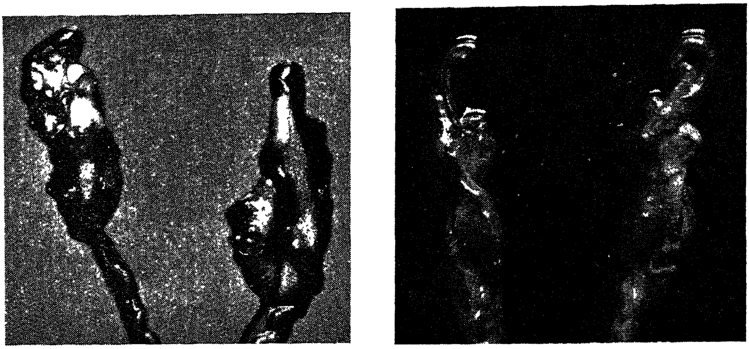

FIG. 2.—Friedman test. (*a*) Positive result; (*b*) negative result

(3)—Differential Diagnosis

This must be made after full consideration of the symptoms and physical signs, with requisition when necessary of such measures as the Aschheim-Zondek or Friedman test and radiography. There must now be few cases indeed in which the question of pregnancy cannot be settled, if full and intelligent use is made of the various available aids. Difficulties usually arise in the first three months, when in a stout or resistant patient it may be yet impossible to distinguish clearly the enlargement of the uterus. In such a case reliance must be placed on such evidence as the Aschheim-Zondek test, breast signs (if the patient is a primigravida), and the softening of the cervix. If these are not helpful or available, it is always wise to postpone judgement until more positive signs present themselves. Difficulty too may arise in the differentiation of a retroverted gravid uterus from a fibroid in the wall of a non-pregnant uterus. Here the presence of amenorrhoea and a positive Aschheim-Zondek or Friedman test will help.

Generally speaking, it may be assumed that the sudden cessation of menstruation in a woman previously regular is due to pregnancy, until the contrary is proved The diagnosis between acute or subacute hydramnios and an ovarian cyst may occasionally present difficulty (see p. 66), as may the question of the presence of an ovum in a uterus containing multiple fibroids.

3.–ABNORMALITIES IN THE QUANTITY OF AMNIOTIC FLUID

(1)—Hydramnios

1293.] Hydramnios is an excess of liquor amnii sufficient to cause abnormality in pregnancy or labour.

Aetiology

Just as little is known regarding the origin of the normal liquor amnii, so the causes of hydramnios are only imperfectly known. They may be divided into maternal and foetal.

Maternal causes

Heart disease *Diabetes* *Multiparity*

(i) Heart disease with severe congestive failure and oedema is one of the rarer causes, and it is probable that the hydramnios is due to back pressure. (ii) Diabetes mellitus. It is believed that the sugar in the liquor amnii stimulates the amniotic epithelium to secrete more fluid. (iii) Multiparity. It is possible that the laxity of the abdominal wall and the diminished tone in the uterus are predisposing factors.

Foetal causes

Chorio-angioma *Anencephaly* *Twinning* *General dropsy of foetus* *Syphilis* *Obscure cases*

(i) Chorio-angioma of the placenta is very often associated with hydramnios. Of 110 cases of chorio-angioma collected by Siddall hydramnios was present in 32·7 per cent, and Kraus found it in 9 out of 14. The excess of fluid is believed to come from the enormously dilated foetal vessels in the villi. (ii) Anencephaly. Hydramnios in connexion with this malformation is exceedingly common and is often of a very severe degree. It is believed that the excess arises from two causes: first, a transudation from the exposed meninges and, secondly, lack of power of the foetus to swallow liquor. The importance of the latter cause is shown by the fact that hydramnios often occurs in congenital closure of the oesophagus. (iii) Multiple pregnancy. Hydramnios occurs in 10 to 20 per cent of uniovular-twin pregnancies. The excess is confined to one sac, usually that belonging to the larger foetus. Since the placental circulations in uniovular twins communicate, it is probable that the cause lies there, though none of the explanations of its occurrence are satisfactory. (iv) General dropsy of the foetus. In this condition there is a primary failure of the blood-forming organs with resulting acute anaemia. The hydramnios can therefore be explained in the same way as the ascites and effusion into the other foetal serous cavities always present in this disease. (v) Syphilis. The chronic form of hydramnios is often found in syphilis. It is believed that the cirrhosis of the foetal liver and partial closure of the umbilical vein are the immediate causes. (vi) Finally, in about 25 per cent no cause for the hydramnios can be discovered. According to Taussig neither the liquor amnii nor the amniotic epithelium shows any abnormality.

Varieties: acute

The acute form is very rare and is nearly always, especially if it occurs in the early months of pregnancy, associated with uniovular twin or triplet pregnancy. The fluid accumulates rapidly from the start, so that in a few days the uterus becomes distended to such an extent as to cause serious distress. The chronic form commonly makes its appearance in the later months. The fluid gathers slowly and therefore rarely causes much distress. The term subacute is self-explanatory.

Chronic

Subacute

Clinical picture: acute form

In the acute form, which rarely sets in before the eighteenth week, the abdomen is much distended and tense, so that, especially if pregnancy has not advanced very far, no foetal parts may be felt. There may be oedema of the feet, legs, and vulva from pressure, and hyperemesis may be a prominent feature. There may be abdominal pain from distension, dyspnoea from pressure on the thorax, and rapid pulse and palpitation on slight exertion. The abdomen is tender, there is a fluid thrill, and it may be impossible to hear the foetal heart sounds. Intermittent contractions, however, can generally be elicited, and a uterine souffle—of great diagnostic value—can often be heard.

Chronic form

In chronic hydramnios the only complaint may be of difficulty in getting about, or there may be pressure signs, such as slight oedema of the lower extremities.

Course and prognosis

Apart from the acute form, which is exceedingly rare, and the complications mentioned above, most patients do well. Especially in the subacute form labour is apt to be premature, whereas in the acute form it is always necessary to induce abortion or premature labour. Malformations are common, but, if the child is born alive and free from deformity, the outlook for its future is as good as for any other infant, and physically and mentally it is likely to be up to normal standard.

Diagnosis

As a rule diagnosis presents no difficulty. Difficulty may, however, arise in the acute form, which may be met with at such an early stage of pregnancy that none of the absolute signs of pregnancy can be made out. In such cases X-rays and the Aschheim-Zondek test should be used. An attempt should be made to find the cause of the hydramnios. Thus the urine should be tested to exclude diabetes mellitus, a Wassermann reaction done to exclude syphilis, and X-ray examination carried out to exclude foetal malformations.

The following conditions may require to be differentiated from the acute and subacute forms.

Diagnosis from ovarian cyst

Spencer's sign

In ovarian cyst there is no amenorrhoea, and the fluid gathers less rapidly than in acute hydramnios. Intermittent contractions are present in hydramnios, and a souffle can often be heard. Spencer's sign is important, and is elicited as follows: with the patient in the knee-chest position, the foetus falls downwards against the abdominal wall and can be ballotted there.

From retroverted gravid uterus with distended bladder

In retroverted gravid uterus with distended bladder the fundus uteri can be felt in the recto-uterine excavation (pouch of Douglas), the cervix is high up behind the pubes, and passage of a catheter removes the abdominal swelling.

From ascites

In ascites signs of pregnancy are absent, but there is evidence of heart, liver, or kidney disease. There are shifting dullness and dullness in the flank, whereas in hydramnios the dullness is central and the flanks are resonant.

Associated complications of pregnancy and labour

Hydramnios and pre-eclamptic toxaemia are often associated, possibly because both are often found in multiple pregnancy. Diabetes mellitus is not uncommon in the chronic or subacute types, and Poeck in 103 cases found syphilis in 14. Malpresentations are very common on account of the mobility of the foetus. Labour may be complicated by uterine inertia from over-stretching, prolapse of the cord, or post-partum haemorrhage, as well as by the difficulties associated with malpresentations.

Treatment

In the chronic and subacute forms any causal condition suspected, such as syphilis or diabetes mellitus, should be treated. The fluid intake may be limited in the hope that thus the quantity of liquor secreted will be diminished, but it is doubtful if any beneficial effect follows. An abdominal binder helps the patient to get about with more comfort. In the acute form the symptoms are usually so urgent that it is necessary to terminate pregnancy, which may be done by rupturing the membranes. To minimize shock from rapid escape of fluid an abdominal pad should be placed over the navel and a tight binder applied. Puncture of the sac through the abdominal wall has been advocated in the hope of carrying on the pregnancy, and there can be no harm in trying it if X-ray examination shows that the foetus is not deformed; but in about half the cases the patient goes into premature labour afterwards.

Treatment during labour

In labour it is often advisable to rupture the membranes early to relieve distension and help to overcome inertia. The cord is apt to be washed down by the rush of escaping liquor, and there is an increased risk of post-partum haemorrhage.

(2)—Oligohydramnios

This is deficiency of liquor amnii. Any quantity less than one pint may be regarded as unduly small.

Causation

Little is known regarding causation, but two of the chief hypotheses may be mentioned: (i) degeneration or necrosis of the secretory amniotic epithelium, the evidence being far from conclusive; and (ii) atresia of the foetal urinary tract or absence of the kidneys, whereby the foetus is unable to add to the amniotic fluid.

According to Schiller and Toll, there were malformations of the urinary tract in 15 of 57 cases of oligohydramnios reported up to 1927. But numerous cases are recorded in which with absence of both kidneys the quantity of liquor amnii was normal or excessive. All that can be said at present is that on the whole the available evidence tends to show that the oligohydramnios and the deformities in the urinary tract are both due to changes in the germ plasm.

Clinical picture

The uterus is smaller than it should be for the period of pregnancy, and the foetus is very immobile. Apparently breech presentation is common, because in that position the foetus best fits the uterus. Pressure deformities of the foetus, e.g. club feet, are common. In labour the forewaters are absent, and dilatation of the cervix may therefore be slow.

Treatment

No treatment is usually called for.

4.–DISPLACEMENTS OF THE UTERUS IN PREGNANCY

(1)—Retroverted Gravid Uterus

Aetiology

1294.] This condition is usually explained by the occurrence of pregnancy in a uterus already retroverted. Very rarely backward displacement of a uterus that is already pregnant takes place from strain, such as that from lifting a heavy weight, especially when the bladder is overdistended.

Possible terminations: rectification

Abortion

Sacculation

Incarceration

The possible terminations are: (i) spontaneous rectification—the commonest ending; as the uterus enlarges it rights itself; if this occurs it usually does so before the tenth week; (ii) abortion, also a common ending; it may occur before or after incarceration and usually follows the ordinary course; (iii) sacculation, very rare; the uterus remains retroverted, but the growing ovum expands the anterior wall, which forms a large pouch projecting upwards into the abdomen; Caesarean section may be necessary at term, but the pregnancy often ends prematurely; and (iv) incarceration; the uterus in this event becomes imprisoned in the pelvis and causes acute retention of urine. The causes of retention are: (*a*) stretching of the anterior vaginal wall with the contained urethra, the lumen of which is thus much narrowed; and (*b*) compression of the urethra and neck of the bladder by the uterus when it becomes large enough to fill the pelvis, namely, from the end of the twelfth week onwards. If the retention is not relieved, overflow incontinence may set in, followed by acute cystitis. The walls of the bladder become oedematous, and haemorrhagic extravasations may occur under the mucosa and in the muscle and lead to the shedding of large flakes of mucous membrane and even muscle. Rupture of the bladder followed by death from peritonitis may be due to necrosis or to attempts at replacement. Ascending infection may cause pyelonephritis and uraemia.

Clinical picture

Before the twelfth week there are no symptoms unless abortion takes place. After the end of the twelfth week, if the retroversion still persists, increasing difficulty is experienced in micturition till about the sixteenth week, when complete retention occurs, to be followed later by 'overflow incontinence'. The bladder becomes enormously distended, so that it commonly reaches to the umbilicus or above it and causes much discomfort.

In examination *per vaginam* there are two characteristic findings: (i) the large fundus is felt in the pouch of Douglas; and (ii) the cervix is displaced high up behind the symphysis pubis and may point forwards and upwards. The bowel above the fundus is usually loaded with faeces, due probably to the obstruction caused by the pelvic mass.

Termination

If the retention is not relieved, cystitis and kidney infection may cause high temperature, rapid pulse, delirium, coma, and death from uraemia. A very common ending is abortion; this often occurs before serious symptoms of infection appear, usually with marked relief of the retention.

Course and prognosis

In modern times cases of incarcerated gravid uterus are discovered early and treated effectively, so that serious symptoms, such as were common fifty years ago, are now rare. Moreover spontaneous reposition and abortion commonly occur, so that there must be very few obstetricians living to-day who have ever seen a death from incarceration.

Diagnosis

Besides the history, which is often typical, central swelling will be noted in the abdomen reaching to the navel or higher and therefore much too large for the period of amenorrhoea. The swelling is dull on percussion and slightly fluctuant, and passage of a catheter makes it disappear. The findings on vaginal examination are described above and are usually so characteristic as to leave no doubt about the diagnosis.

Differential diagnosis

The following conditions may require to be differentiated.

From fibroid tumour

In fibroid tumour in the posterior wall of a pregnant uterus the fundus is felt in its normal position, and the cervix is not displaced upwards behind the symphysis.

From pelvic haematocele

Pelvic haematocele, arising from a ruptured tubal gestation, may cause a median suprapubic swelling which, however, is sub-tympanitic. If the retroverted uterus is aborting, the haemorrhage may be mistaken for that from the uterus in tubal pregnancy, but the former is usually more severe. Retention of urine is rare and never so severe as in retroverted gravid uterus; the swelling in the recto-uterine excavation (pouch of Douglas) has an indefinite outline, and the cervix is in its normal position.

From ovarian tumour in pouch of Douglas

In ovarian tumour in the recto-uterine excavation (pouch of Douglas) the fundus uteri can generally be felt in its normal anteverted position, and the cervix points downwards and backwards. There is usually no retention of urine.

Treatment

Before incarceration

After incarceration

If the retroversion is discovered before incarceration, the uterus should be replaced manually and a pessary inserted and left in till the fifth month. If it is discovered only after incarceration, the patient should be put to bed and given ½ grain of morphine sulphate, and a catheter should be passed every six hours. The bowels should be emptied, by an enema if necessary. The patient should lie in the prone position and assume the knee-chest posture for ten minutes every hour throughout the day. In 90 per cent of cases the uterus rights itself, largely because the weight of the distended bladder has been removed. If spontaneous reposition has not taken place with this treatment in two or three days, manual reposition should be attempted.

Manual reposition

The procedure does not differ from that usually employed, except that the fundus should be pushed up past the right side of the sacral promontory, where there is more room than on the left. If the attempts fail in the dorsal or the Sims position, they should be repeated in the knee-chest position, and perhaps with the finger in the rectum.

Pessary

If these attempts do not succeed, the practitioner may wait a few days, keeping the patient's bladder and bowels empty in the meantime and continuing the postural treatment. It is well, too, to try the insertion of a rubber ring-pessary as large as can be borne, as advised by Sinclair in 1900. This, by its elastic pressure on the fundus, is often successful. If it fails after a trial of two or three days, further attempts at manual reposition may be made under general anaesthesia. Another method advised is the insertion of a hydrostatic bag in the posterior fornix with the patient in the lithotomy position, then allowing her legs to hang downwards over the edge of the bed or couch in the Walcher position. Finally, it may be necessary to open the abdomen. Some cases of abdominal reposition have been reported in which the laparotomy disclosed the presence of adhesions between uterus and rectum. Such cases, however, are extremely rare, because the pelvic peritonitis that caused the adhesions has usually sealed the Fallopian tubes and made the patient sterile.

Hydrostatic bag

Laparotomy

(2)—Prolapse

Procidentia

This is as a rule troublesome only in the first five months, because after that time the uterus is supported by the pelvic brim. Since, however, the uterus is then held up by the bony ring of the pelvic inlet rather than by the structures which should normally support it, the pressure is liable to cause premature interruption of pregnancy. In complete prolapse (procidentia) the cervix often protrudes through the vulval orifice, even in the later months of pregnancy, and is then liable to become oedematous and ulcerated. In such cases it is useless to wear a pessary, and it is generally necessary to keep the patient in bed, cleansing fomentations being at the same time applied to the ulcerated cervix. The cervix may not dilate well during labour, and it may be necessary to divide it after it has been thinned out by the advancing head.

(3)—Pendulous Abdomen

This condition is often met with in patients with contracted pelves or in multiparae with very lax abdominal walls or wide separation of the recti abdominis muscles. A well fitting abdominal belt should be worn to enable the patient to get about with some comfort. It may be necessary to treat intertrigo, which is often present in the skin of the lower abdomen.

5.—HAEMORRHAGES

(1)—Definitions

1295.] The haemorrhages of pregnancy may be divided into those occurring before and those occurring after the twenty-eighth week, i.e.

the period of viability of the child. The former are described under threatened abortion (see Vol. I, p. 55), ectopic pregnancy (see Vol. V, p. 258), and hydatidiform mole (see Vol. III, p. 216).

The haemorrhages occurring after the twenty-eighth week are called ante-partum haemorrhages.

Ante-partum haemorrhages

(2)—Aetiology

Premature separation of the placenta is by far the commonest cause of ante-partum haemorrhage. Haemorrhage due to premature detachment of a placenta in the normal situation, i.e. the upper uterine segment, is called accidental haemorrhage; haemorrhage due to separation of a placenta partly or wholly in the lower uterine segment, i.e. placenta praevia, is called unavoidable haemorrhage. Rarer and less important causes of ante-partum haemorrhage are uterine or cervical polypi, cancer of the cervix, and varicose veins of the cervix.

Premature separation of placenta

Accidental haemorrhage

Unavoidable haemorrhage

(3)—Unavoidable Haemorrhage from Placenta Praevia

(*a*) *Definition*

This is haemorrhage from a placenta praevia, i.e. a placenta partly or entirely in the lower uterine segment.

Although in the foregoing section the term ante-partum haemorrhage is restricted to haemorrhage after the twenty-eighth week, haemorrhage may occur from separation of a placenta praevia at any time after the formation of the discoid placenta, i.e. after the end of the third month. It is, however, convenient for clinical purposes to limit the term as above, chiefly because before the twenty-eighth week the bleeding is not likely to be severe, though fatal cases have been recorded at the fourth month. The term 'threatened miscarriage' or 'threatened abortion' is usually applied to haemorrhage before the twenty-eighth week.

Threatened abortion

(*b*) *Aetiology*

Causation

Contractions of the uterus in labour stretch the lower uterine segment, which is thus unavoidably detached from the placenta praevia, causing haemorrhage. Another cause is the normal gradual stretching of the lower uterine segment in the later months of pregnancy.

Incidence

Unavoidable haemorrhage therefore often starts in the later months of pregnancy; the liability to it increases as term approaches and is greatest in labour, because the lower uterine segment is then being rapidly stretched and torn from its placental attachment.

Aetiology of placenta praevia

Little is known about the cause of placenta praevia. The condition is commoner in multiparae, especially those who have borne children in rapid succession. In the series of 4,406 cases collected by Comyns Berkeley 20 per cent were in primigravidae. It occurred more often, however, in the first than in any subsequent pregnancy. Thus, of the series, 886 occurred in the first pregnancy, 750 in the second, 634 in the third, 506 in the fourth, and 359 in the fifth. It is much commoner in plural pregnancy, as would be expected from the larger size of the placenta.

Incidence

Causation The greater frequency in multiparae was ascribed by the older writers to chronic endometritis, but chronic endometritis occurs very rarely if at all. A reasonable view is that first advocated by Robert Barnes in 1858, i.e. that the placenta develops partly on the decidua capsularis as well as on the decidua basalis. This hypothesis was elaborated in 1888 by Hofmeier but does not explain why the villi on the decidua capsularis fail to atrophy as they normally should.

(c) *Varieties of Placenta Praevia*

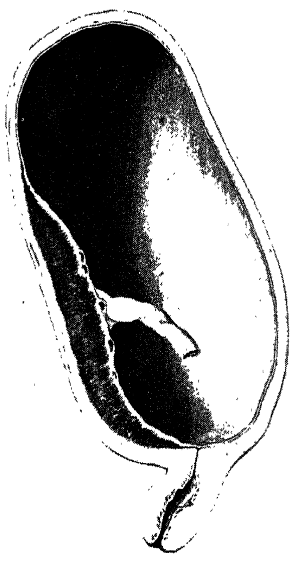

FIG. 3.—Placenta praevia, second degree (marginal)

Partial Placenta praevia may be partial or complete. Partial placenta praevia means that no part of the placenta overlaps the internal os when it is closed. In about 90 per cent of all cases the placenta praevia is partial. *First degree (lateral)* This type is further divided into lateral, in which only the lower part of the placenta is attached to the lower uterine segment, *Second degree (marginal)* and marginal, in which its lower edge reaches the margin of the internal os when closed (see Fig. 3). These are better called placenta praevia of the first and second degrees respectively. *Third degree (complete)* A complete placenta praevia overlaps the internal os when closed but no longer covers it when dilated; this is better called placenta praevia of the third degree (see Fig. 4). *Fourth degree (central)* Finally there is central placenta praevia or placenta praevia of the fourth degree (see Fig. 5), in which the closed internal os corresponds roughly to the centre of the placenta and is covered even when fully dilated. This last type is rare.

(d) *Morbid Anatomy*

Placenta membranacea The placenta is often abnormally wide, covering a larger uterine area than usual—placenta membranacea—and it is often abnormally *Placenta accreta* adherent—placenta accreta—probably owing to imperfect formation of the decidua of the lower segment, one function of the decidua being the prevention of undue penetration by the chorion. The placenta was abnormally adherent in 13 per cent of Schweitzer's 333 cases.

Lower uterine segment The lower uterine segment in placenta praevia is unduly vascular and soft and therefore tears easily like wet blotting-paper; a tear starting in the cervix can easily extend up into the body of the uterus and cause a serious or even fatal post-partum haemorrhage. Post-partum haemorrhage from such tears or from the placental site is difficult to control, the lower segment having no power of contraction and but little of retraction. The raw placental site, owing to its low situation, is particularly liable to infection from the vagina, especially as the patient is often exsanguinated and therefore in no condition to resist it.

Foetal malformations

There is evidence that malformations of the foetus, especially spinal and cranial defects, e.g. spina bifida and anencephaly, are unduly common in placenta praevia. The relationship between them and the abnormal situation of the placenta is unknown.

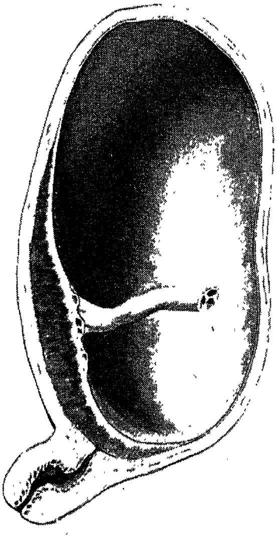

FIG. 4.—Placenta praevia, third degree (complete)

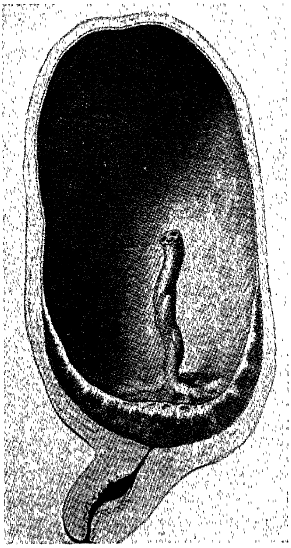

FIG. 5.—Placenta praevia, fourth degree (central)

(e) *Clinical Picture*

The only symptom of placenta praevia is bleeding, which is typically painless, recurrent, and not associated with preceding toxaemia or hypertension, which can often be invoked as a cause of accidental haemorrhage (see p. 85). It is not accompanied by any degree of the severe abdominal pain that is often present in the latter (see p. 87). The bleeding always tends to recur until the portion of the placenta attached to the lower segment has been completely separated.

Onset

The bleeding often occurs at night, the patient awaking to find herself faint and the bed beneath her wet with blood; but it may start while she is sitting in the lavatory or is engaged in her household duties. At first it may be slight, a mere 'show' or 'warning haemorrhage' which

'Warning haemorrhage'

the patient is apt to ignore, or it may be fatal at the first onset. Usually several fluid ounces of blood are lost, enough to cause her to seek advice.

The time of first onset of bleeding varies, but it nearly always sets in before term; only 5 per cent of Pankow's cases had reached term when bleeding began. It most commonly sets in after the sixth month and is seldom severe before the end of the seventh. Generally speaking, the more complete the degree of placenta praevia the earlier the haemorrhage starts and the more severe it is likely to be. There are, however, many exceptions to this rule, and a patient with central placenta praevia may have the first bleeding at term.

Revealed haemorrhage

The bleeding is practically always revealed or external, i.e. it escapes from the uterus, thus differing from accidental haemorrhage, which may be concealed within the uterus (see p. 87).

If the haemorrhage has been severe, the patient is more or less exsanguinated and her pulse correspondingly rapid and weak. Labour pains may or may not be present. If they are present, a fresh haemorrhage is liable to occur with each pain, but it may not, as each contraction does not necessarily result in separation of a fresh piece of placenta.

Abdominal examination

Little abnormal is usually detected. There may be a malpresentation, and a presenting vertex is liable to be situated very high above the pelvic inlet, because the low placenta fills up the inlet. Since the patient is usually a multipara, an unengaged head before the onset of labour is not abnormal.

Vaginal examination

If the placenta overlaps the internal os and the cervix is sufficiently dilated to admit a finger, the maternal surface of the placenta can be easily palpated through the os. If the placenta praevia is partial, the edge is felt at a greater or less distance above the internal os. If, as rarely happens, the internal os is closed, it is impossible to palpate the placenta through it; but it may still be possible in favourable circumstances—the head presenting and a thick placenta—to recognie the placenta like a 'wetted bath sponge' between the head and the examining finger.

(*f*) *Effect on Pregnancy and Labour*

Malpresentations

Malpresentations are common, because the low placenta usually prevents the head from settling down into the pelvis. Pankow found that 68·8 per cent of 914 collected cases were vertex presentations, 21·2 per cent shoulder, and 10 per cent breech.

Premature delivery

Haemorrhages are liable to occur from the early months of pregnancy, and 40 to 50 per cent of the deliveries are premature (44·3 per cent of Pankow's series).

Primary uterine inertia

Primary uterine inertia is apt to complicate labour; this is probably partly due to ante-partum haemorrhage which renders the uterus atonic and partly due to the presenting part being high and not pressing on the cervix.

The cervix is extremely liable to tear on account of its softness and vascularity; the tear may extend into the lower uterine segment and cause serious post-partum bleeding. The lower uterine segment is unable to contract and retract properly; this also predisposes to post-partum haemorrhage and makes its control difficult.

Post-partum haemorrhage

There is an increased risk of puerperal sepsis after placenta praevia, because (i) loss of blood predisposes the patient to infection; (ii) the placental site is close to the vagina; and (iii) frequent manipulations may be necessary before or during labour.

Puerperal sepsis

Finally the placenta is liable to be abnormally adherent.

(g) *Course and Prognosis*

In the large majority of cases the prognosis is favourable at least as regards the mother. After a few more or less severe haemorrhages labour pains start. In a favourable case the uterine contractions soon drive the presenting part downwards into the pelvis, thus compressing the placental site and preventing further loss of blood. Many cases end spontaneously and satisfactorily without any interference or treatment. There is always, however, a grave risk of severe and even fatal haemorrhage either before, during, or after labour, or, if delivery is safely accomplished, the patient may die from puerperal sepsis.

The following figures, which I have collected from the reports of eleven teaching hospitals in Great Britain, indicate the mortality. Of 3,103 cases, complete and partial, the maternal mortality was 5·9 per cent and the foetal 54·2 per cent. These included 2,432 cases of partial placenta praevia with a maternal mortality of 4·4 per cent and a foetal of 52·2 per cent and 671 cases of complete placenta praevia with a maternal mortality of 11·8 per cent and a foetal of 60 per cent. The maternal mortality from the complete type is therefore almost three times that from the partial. The chief causes of death are haemorrhage (65 per cent) and sepsis; rarer causes are air embolism, pulmonary embolism, and shock from extensive tears of the cervix and lower uterine segment.

Mortality

Causes of death of mother

The value of skilful treatment is shown by Stratz, who had a maternal mortality of 0·6 per cent in 173 cases. No doubt the maternal and foetal mortality could be much lowered if patients were sent to hospital early and neither examined nor packed before admission. Schweitzer found that the maternal mortality from sepsis among patients sent to hospital immediately and without a vaginal examination was nil; in those who had been examined *per vaginam* but not otherwise interfered with it was 2 per cent; in those who had had a vaginal pack inserted it was 6 per cent; and in those who had had other internal manipulations it was 11 per cent.

Effect of treatment

The high foetal mortality is due to various causes. Prematurity is common; the placental separation is very liable to cause asphyxia; and most of the methods of treatment involve compression of the placenta and interference with the placental circulation.

Causes of death of foetus

(*h*) *Diagnosis and Differential Diagnosis*

Minor causes of ante-partum haemorrhage, e.g. mucous and fibroid polypi and cancer of the cervix, can only be excluded by vaginal examination, preferably by passing a speculum and viewing the cervix. Apart from these the diagnosis lies between unavoidable haemorrhage and accidental haemorrhage.

Diagnosis from accidental haemorrhage

History

Unavoidable haemorrhage usually occurs in a multipara, but there are many exceptions. There is not any history pointing to pre-eclamptic toxaemia. The bleeding is typically painless, causeless, and recurrent, and there are no symptoms other than those referable to loss of blood. In accidental haemorrhage there is usually a history of pre-eclamptic toxaemia, and the bleeding is not necessarily recurrent; in the concealed type of accidental haemorrhage there is acute abdominal pain.

Abdominal examination

In unavoidable haemorrhage the abdomen appears normal. The foetal parts are easily palpated, and the heart sounds are usually audible. Malpresentations are common, and, if the vertex is presenting, the head is usually high above the pelvic brim. In the concealed type of accidental haemorrhage the abdomen is hard, of rather woody consistence, and often extremely tender, and the foetal parts are impalpable on account of the rigidity of the abdominal muscles. The foetal heart sounds are inaudible, the foetus being nearly always killed by the retroplacental clot. In entirely revealed accidental haemorrhage the foetal parts can be easily palpated, malpresentations are not unduly common, and the head is often engaged in the pelvis. Although in placenta praevia the head is usually not engaged in the pelvis, this may occasionally occur, because the thin membranous placenta may not be thick enough to prevent its descent.

Vaginal examination

Vaginal examination is usually necessary for exact diagnosis of the cause of ante-partum haemorrhage, except in the concealed type of accidental haemorrhage, when abdominal examination is sufficient. The vaginal examination must be carried out according to a strict antiseptic and aseptic method, because the danger of infecting the exsanguinated patient is very great. Vaginal examination may start a fresh and dangerous haemorrhage; *it is therefore very unwise to make a vaginal examination unless all preparations have previously been made to deal with haemorrhage*, and in a patient who has already lost much blood these should include preparations for blood transfusion and Caesarean section. For a satisfactory examination the patient should be in an operating theatre, and an anaesthetic is generally advisable. It is usually necessary to introduce the whole hand into the vagina, the cervix being high up and difficult to reach, and the finger must be passed through the internal os, which is nearly always sufficiently dilated to admit the forefinger. If the placenta overlaps the os it is easily felt and recognized. It is soft, spongy, and not friable. This absence of friability is the chief point of distinction from blood-clot, with which it is apt to be confused. If the finger on passing through the os comes into

Recognition of placenta

contact not with the placenta but with the presenting part, the case may still be one of partial placenta praevia, and the examining finger should be pushed upwards along the lower segment of the uterus, feeling its wall first on one side and then on the other, then in front and behind. With the whole hand in the vagina, it is usually possible to push the finger upwards three or four inches inside the internal os and so to palpate the entire lower segment. The edge of the placenta may be felt reaching to the margin of the os—marginal or second degree placenta praevia—or it may be only reached higher up but still within the lower segment—lateral or first degree placenta praevia. If the placenta cannot be palpated at all in the lower segment, the diagnosis is accidental haemorrhage. If the os does not admit a finger, an attempt may be made to feel the placenta through the fornices, where it may occasionally be felt intervening between the finger and the presenting part. This is not usually satisfactory, and, if the os is closed, the diagnosis is nearly always left in doubt, unless the recently introduced method of X-ray is is available.

X-rays

In 1930 Menees, Miller, and Holly showed that by injecting a solution of an opaque substance, strontium iodide, into the amniotic cavity it was possible to outline the placenta and thus to reveal its site. The method was used by Munro Kerr and Mackay in ten cases of placenta praevia, but in three it caused death of the foetus, and the use of strontium iodide was therefore discontinued. They then used uroselectan-B, which is non-toxic and non-irritant, and found it satisfactory in a further ten cases. The technique of amniography is described in LABOUR, Vol. VII, p. 590. *Techniqu*

(i) *Treatment*

General principles

(i) Mortality is much higher in domiciliary practice than in institutions, partly because the judgement and dexterity necessary in the selection and application of methods of treatment can only be acquired by those who handle numbers of cases, and partly because in domiciliary practice such important life-saving measures as blood transfusion are not often available.

(ii) Mortality would be much reduced if patients were received earlier in hospitals or similarly equipped institutions. As in appendicitis, the mortality in placenta praevia is largely a mortality of delay.

(iii) Mortality would be much reduced if patients were neither examined *per vaginam* nor packed before admission (see p. 75).

(iv) As haemorrhage and sepsis are the two commonest causes of maternal death, every effort must be directed, from the time the patient is first seen, to prevent loss of blood before, during, and after delivery and to the performance of such manipulations as are necessary with scrupulous regard to surgical cleanliness. The prophylactic and therapeutic value of blood transfusion must be kept continually in mind.

(v) A 'warning' haemorrhage should be the signal for immediate removal of the patient to hospital or to an institution with equal facilities for diagnosis and treatment.

Domiciliary treatment

This is contra-indicated. On being called to the case the practitioner should make a general and abdominal examination, but the patient should not be examined *per vaginam*. There are several reasons for this: (i) it is not usually possible to reach high enough to get a finger through the internal os unless the patient is under a general anaesthetic; (ii) vaginal examination may cause a sudden severe haemorrhage, with which it may be impossible to deal effectively; and (iii) in vaginal examinations there is always a risk of introducing sepsis.

Vaginal examination contra-indicated

Vaginal pack contra-indicated

Nor should a vaginal pack be inserted before removal to the institution. The pack is supposed to control bleeding from the placental site by exerting pressure upon it through the fornices. It can do so if the membranes are ruptured and the presenting part is low down in the pelvis, but in unavoidable haemorrhage the membranes are nearly always intact and the presenting part is high. Even if a tight abdominal binder is applied to press the presenting part downwards as much as possible, it is unlikely that the bleeding placental site will be effectively compressed between the presenting part and the pack. In practice the pack is not a certain method of controlling bleeding in placenta praevia; it is often soaked through shortly after insertion. Further, if a pack is to be inserted properly, a general anaesthetic must be given. A more serious objection to it is that it is rarely possible outside an institution to insert the pack without a serious risk of introducing sepsis, and it nearly always limits the surgeon's choice of treatment when at last the patient comes under his care. Caesarean section, for example, is practically ruled out in a patient who has been packed before admission; and even such a procedure as version and extraction of the foetus is attended by a much higher maternal mortality if the patient has been previously packed (see p. 82). It is often claimed as one of the advantages of the vaginal pack that it excites uterine contractions and thus leads to greater dilatation of the os. Whatever advantages attend this result in hospital, none can be claimed for it in a patient who is to be removed to an institution, because uterine contractions that lead to further haemorrhage are undesirable.

Abdominal binder

Vulval pad

After the general and abdominal examination a tight abdominal binder should be applied, coming well up over the fundus, and a sterile vulval pad, kept in place by a perineal bandage pinned to the binder behind and in front. A hypodermic injection of morphine sulphate should be given and the patient removed as gently and quietly as possible to hospital. As much water may be given her as she wishes to drink, and she should be accompanied by the practitioner or the nurse.

Hospital treatment

The patient's blood group should be ascertained, and, if the haemorrhage has been so severe that immediate interference is desirable, the blood donor should have reached the hospital before treatment is begun.

(i) *Expectant treatment*

Expectant treatment is indicated in slight ante-partum haemorrhage that does not recur more than once or twice after rest and sedatives in a patient who is willing to remain in hospital until delivery. In the hospital, or living not more than five to ten minutes away, should be someone competent to initiate active treatment and to carry it through should an emergency arise. The patient should be kept in bed until a week or ten days after all bleeding has ceased, and in the meantime sedatives, e.g. morphine, bromides, and chloral hydrate, may be administered and only gentle laxatives used. The diet should be light and contain a fair proportion of eggs, green vegetables, fruit, and brown bread, which are likely to regulate the bowels without the help of drastic aperients. No vaginal examination with the fingers is made, but a speculum should be passed to view the cervix and to exclude rarer causes of haemorrhage, e.g. cancer of the cervix, polypus, cervical erosion, and varicose veins of the cervix. A very large proportion of patients treated thus go to term without further bleeding and have a safe and spontaneous delivery with little or no haemorrhage; 18 per cent of the 3,103 cases mentioned on page 75 ended thus, with a maternal mortality of 2·7 per cent and a foetal mortality of 34 per cent.

Rest

Sedatives

Diet

Vaginal examination

(ii) *Active treatment*

Patients who have had severe haemorrhage before admission—judged more by the effect on the patient than by the history obtained—or in whom the haemorrhage continues or recurs more than once or twice in spite of rest and sedatives are unsuited for expectant treatment and must be treated actively at once. A thorough preliminary examination must be carried out to determine the exact degree of placenta praevia and the size of the os. This examination should never be made in the ward, or even in the labour ward or delivery room, but only in the operating theatre, and all preparations should be made for Caesarean section and blood transfusion, and, if the patient has already lost much blood, a donor should have reached the hospital. A general anaesthetic should be given. The patient should be in the lithotomy position, and the vaginal examination should be carried out with the most strict regard to antisepsis and asepsis. The operator should be masked and gloved. The vulva should be shaved, washed with soap and hot water or with ether soap, dried, and painted with an antiseptic, e.g. equal parts of 1 in 1,000 solution of acriflavine and of brilliant green in industrial spirit. The vagina should be douched with 1 in 4,000 solution of mercuric chloride or of red mercuric iodide or painted with the above-mentioned solution of acriflavine and brilliant green. If this paint is used, it is well to swab the vagina first of all with sterile solution of sodium bicarbonate in water, 60 grains in 1 pint, in order to remove mucus and thus to allow the antiseptic to reach the vaginal mucosa.

Examination

Preparation of vagina

Ironing out the vagina

To make a satisfactory examination it is usually necessary to insert the whole hand into the vagina. Unless therefore the vagina admits the hand it should be first ironed out in the following way: the labia should be separated and concentrated sterile soap solution poured into the vagina; two fingers are now passed up to the posterior fornix and brought down the posterior vaginal wall to the vulva with a firm stroking movement so as to stretch it. This is repeated with three or four fingers successively, and finally the whole hand can be easily introduced. Throughout this procedure large quantities of lubricating soap solution must be used, because it minimizes trauma to the vaginal epithelium.

Methods of controlling haemorrhage

All the methods of treatment available, except Caesarean section, aim at control of the bleeding by pressure on the placental site. This pressure may be exerted by the foetal head when pushed down on to the placenta by the contractions of the uterus, by the head being pulled down on to the placental site by a scalp forceps (see p. 81), by the half breech of the foetus after bringing down a foot on which traction can be made, by a hydrostatic bag introduced inside the membranes and with a weight attached, by rupture of the membranes and application of a tight binder, and by a vaginal pack.

Artificial rupture of membranes and application of tight binder

The artificial rupture of the membranes and the application of a tight binder is an excellent method of treatment in partial placenta praevia when haemorrhage is slight and pains are present. It was the method of treatment in 414 (13 per cent) of the 3,103 cases mentioned on page 75, the maternal mortality being 2·2 per cent and the foetal 43·5 per cent. The objections formerly urged against it, that, if haemorrhage is not controlled, version is often impossible, because the liquor amnii is drained away, no longer holds, because Willett's forceps can still be applied to the scalp. It has the great advantage that it involves a minimum of manipulation and is available as soon as the os admits a finger. The binder should be applied so as to come well up over the fundus and to press the presenting part downwards as far as possible.

Pressure by half breech on placental site

Pressure by the half breech on the placental site is a time-honoured method of treatment. If the breech is presenting, it is only necessary to extract a foot; a weight of about two pounds is attached to this by a sterile gauze strip and allowed to hang over the end of the bed. If the vertex is presenting, external podalic version can be done and the foot thus extracted (see Fig. 6). If the os is half or more dilated, internal podalic version can be performed but has the obvious disadvantage that more internal manipulation is necessary, and this should be avoided as far as possible. External version should therefore be preferred and is usually possible because the foetus is so often premature. If external version is impossible and the os is insufficiently dilated for internal version, the bipolar version of Braxton Hicks should be carried out (see Vol. VII, p. 551).

Version

One of the disadvantages of version in placenta praevia is that the os must be large enough to admit two fingers to allow the extraction of a foot, and this seriously limits its usefulness, because it is never permissible to dilate the cervix manually owing to the danger of tearing it. It is, however, an excellent, perhaps the most effective, method of controlling haemorrhage.

Once a foot has been extracted, delivery should not be hurried but should be allowed to take place spontaneously. This minimizes the risk of tearing the cervix and lower uterine segment. If the patient is in a condition of shock or is suffering severely from loss of blood, the interval between version and delivery should be used to restore her as much as possible, if necessary by blood transfusion.

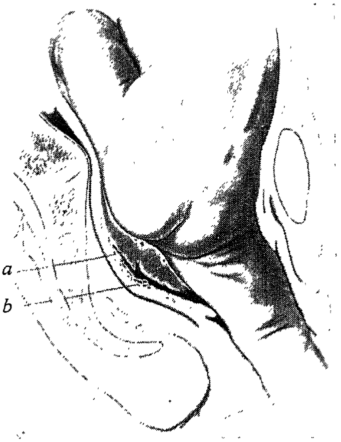

FIG. 6.—Foot brought down in placenta praevia; *a*, opened utero-placental vessels; *b*, marginal sinus of placenta

Results of version

The results from version are ~~good~~ for the mother, but the foetal mortality is very high, because not only is the placenta continually compressed by the half breech, but the foetus is subjected to all the dangers incident to breech delivery. Stratz, in 110 cases treated by bipolar version, reported a maternal mortality of 0·9 per cent and a foetal mortality of 64 per cent. In the 3,103 cases mentioned on page 75, 1,022 were treated in this way, the maternal mortality being 7·3 per cent, and the foetal 80·5 per cent. The maternal mortality is lowest after external version, but the kind of version carried out, whether external, internal, or bipolar, has little or no influence on the foetal mortality.

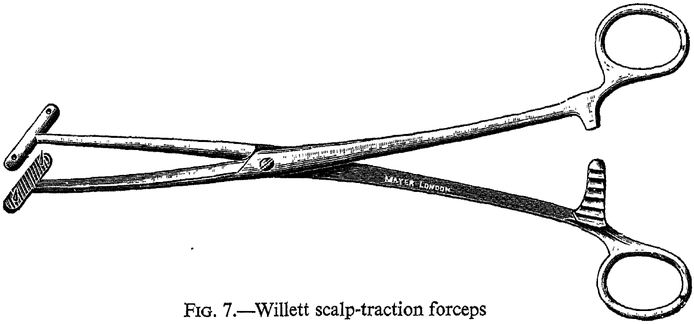

FIG. 7.—Willett scalp-traction forceps

Willett scalp-traction forceps

The Willett scalp-traction forceps (see Fig. 7) was introduced in 1924 by J. A. Willett. It is a modification of de Martell's surgical forceps with the length increased and is applied as follows. The vertex must present or be made to present by external version. After rupture of the membranes a finger is passed through the internal os till it comes in contact with the scalp. The forceps is introduced closed along the finger till it also touches the scalp. An assistant now presses the foetal head downwards as far as possible and maintains pressure so as to fix it, while at the same time the operator opens the forceps widely and then, while pressing firmly against the head, closes them, thus getting a good bite of the scalp. A weight of 1½ pounds is then attached to the handle and labour allowed to proceed naturally. The advantages of the forceps are (i) that it can be applied when the os admits only one finger and is therefore too small for version; (ii) little internal manipulation is necessary; and (iii) the child is spared the dangers attendant on breech delivery, and the foetal mortality rate is therefore lower than after version. Its only disadvantage is that it is sometimes difficult to apply, especially if the scalp is tense, and hence the forceps may tear off when the weight is attached. Very rarely does the forceps cause any serious injury to the scalp. It is unsuited for cases in which the placenta overlaps the os, though it has been used in such with success. In the series of 3,103 cases mentioned on page 75, Willett's forceps was used in 252, the maternal mortality being 3·5 per cent and the foetal 46·4 per cent.

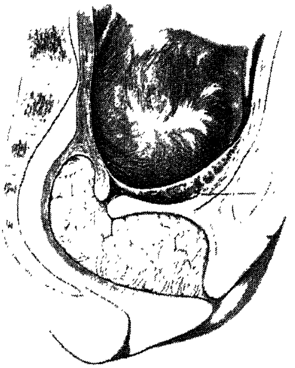

FIG. 8.—Vaginal pack in placenta praevia

Vaginal pack The very old method of treatment by vaginal pack (see Fig. 8) has been largely discarded in American and Continental clinics but is still much used in Great Britain when the os is closed and when therefore no other method of vaginal treatment is possible. Its many disadvantages have been already mentioned (see p. 78). Whereas fairly good results can be obtained from the pack alone, if it fails to control haemorrhage and must therefore be followed by some other internal manipulation the death-rate from sepsis becomes extremely high. In the series of 3,103 cases (see p. 75) 183 were treated by vaginal pack alone, the maternal mortality being 10 per cent and the foetal 65·5 per cent. In 85 cases, however, the pack was followed by version and extraction of a foot, and in these the maternal mortality was 20 per cent and the foetal 94·1 per cent. The experience of Munro Kerr and of Watson and Miller was similar—a maternal mortality from pack followed by version of 14·3 per cent and 18 per cent respectively. Stratz condemned the pack and did not use it in any of his cases.

If, therefore, the os is closed and bleeding is sufficiently severe to make expectant treatment undesirable, it is best to perform Caesarean section.

Hydrostatic bag

In treatment with a hydrostatic bag a sterilized rubber bag is introduced by means of a special forceps through the cervix into the amniotic cavity. It is then filled with sterile water by means of a syringe and the tap closed (see Fig. 9). Bleeding from the placental site can then be controlled by making traction on the bag when bleeding occurs, or a weight of 1½ to 2 pounds may be attached to it. The bag has several disadvantages: (i) the rubber perishes quickly; (ii) the bag is liable to cause malpresentations, e.g. shoulder, by displacing the presenting part; and (iii) bleeding is apt to continue after the bag is expelled, and this may make it necessary to follow it by version and extraction of a foot or by Willett's forceps. Its one advantage is that, as it obviates the dangers of breech delivery, the foetal mortality is somewhat lower than after version. The bag is little used in British clinics. Thus of the 3,103 cases collected by me from eleven British teaching hospitals (see p. 75), only 20 were treated by it, the maternal mortality being 5 per cent and the foetal 66·6 per cent.

Disadvantages

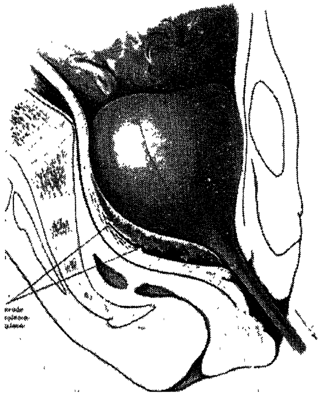

FIG. 9.—Hydrostatic bag in placenta praevia; *a*, bleeding utero-placental vessels. Arrow shows direction of traction

Caesarean section

Caesarean section (see Vol. VII, p. 552), since its first performance for placenta praevia by Lawson Tait in 1890, has increased rapidly in favour. It has many advantages: (i) it can be carried out when the os is closed, and when therefore no other method of treatment than the septic and unsatisfactory vaginal pack is available; (ii) it effects delivery with a minimum of blood loss and without any of the tearing of the cervix which is such a common source of post-partum haemorrhage and shock; and (iii) it gives the child the best possible chance of survival. Since so many of the infants are too premature to survive and others have died from placental separation before treatment is started, the foetal mortality can never be much below 25 per cent. The classical operation is usually performed and has the advantage that the placental site can be completely avoided in opening the uterus; but many authorities prefer the lower segment operation, claiming that, as the placental site is rendered more accessible, any haemorrhage from it can be easily controlled by mattress sutures.

Results

In my series of 3,103 collected cases, 495 were treated by Caesarean section, the maternal mortality being 4·4 per cent and the foetal 23·2 per cent. In 270 of these the placenta praevia was complete or central, and in them the results were remarkably good, i.e. a maternal mortality of 2·2 per cent and a foetal mortality of 24·5 per cent. This was by far the best result obtained in complete placenta praevia by any method of treatment, the next best being obtained from spontaneous delivery, in which the maternal and foetal mortality were respectively 5·9 per cent and 70 per cent. It must be recognized too that a large proportion of these cases were received in hospital late and not infrequently after vaginal packing had been carried out. If patients were received early and before any vaginal manipulation or examination had been attempted, and especially if blood transfusion were used as a routine when necessary, the results from Caesarean section might be much improved.

Indications

It may therefore be said that Caesarean section is the method of choice in the following conditions: (i) when the os is closed and the bleeding is sufficiently severe to demand immediate treatment, the only alternative being the vaginal pack, which should be discarded; (ii) in complete or central placenta praevia when the os is less than half dilated, especially if the child is alive and viable; (iii) in an elderly primipara or any woman who demands a live child, if the foetus is alive and viable, whatever the degree of placenta praevia, provided that the haemorrhage is severe enough to call for active treatment; and (iv) in cases complicated by some other obstetrical complications, e.g. disproportion.

Management of third stage

Unless there is post-partum haemorrhage, the placenta should be allowed to separate naturally. If post-partum haemorrhage occurs, management must be along the usual lines, but the special liability to bleeding from the placental site and from cervical tears must be kept in mind. Full preparation should therefore be made in advance for treatment of post-partum bleeding; materials for blood transfusion, pituitary extract, ergometrine solution, hot douches, gauze for packing, a speculum for exposing the cervix, and needles, catgut, and a needle-holder should be ready. Bleeding is apt to occur from the placental site, because the lower uterine segment has little power to contract and retract, and hot douches, bimanual compression, and intra-uterine and vaginal packing may all be needed for its control. More frequent, however, is bleeding from cervical tears. If this is suspected, the cervix must be exposed *per speculum* and rapidly sutured, preferably with a double continuous catgut-suture with a knot on the end, each stitch being locked by catching it up in the one before.

The great danger of post-partum haemorrhage must never be forgotten. Most patients who die of haemorrhage do so not before or during delivery but after the child is born, because a small loss then that would not matter much in the ordinary patient may be the last straw in one already severely exsanguinated. A wise accoucheur will therefore control the fundus himself and thus as far as possible prevent further blood loss.

Blood transfusion

A realization of the prophylactic and therapeutic value of blood transfusion and its use in serious cases is one of the most important advances made in the treatment of placenta praevia in recent years. Every patient on reaching hospital should be grouped, and in a case in which blood loss has been severe a donor should have reached hospital and all preparations for transfusion be made before any manipulation or even vaginal examination is undertaken. This applies also to Caesarean section, when the transfusion may well be done while the operation is proceeding or even before it is begun. In cases treated by version it may be suitably given after the foot has been brought down. Given at this time it has also a prophylactic value, for loss of blood leads to atonicity of the uterus and thus predisposes to post-partum haemorrhage. Its value has been strikingly shown by Bill who with it reduced his maternal mortality from 11 to 1·78 per cent. He transfuses before delivery every patient whose red-cell count is below 3,000,000 and blood-pressure below 90 systolic and 60 diastolic. If blood transfusion is not available, saline or gum-saline infusion may be used but is less effective. (See also BLOOD TRANSFUSION, Vol. II, p. 530.)

(4)—Accidental Haemorrhage

(*Synonyms.*—Premature separation of the normally situated placenta; ablatio placentae; abruptio placentae; utero-placental apoplexy; haemorrhagic infarction of the uterus)

(*a*) *Definition*

This is haemorrhage arising from premature detachment of the normally situated placenta, i.e. a placenta situated entirely in the upper uterine segment.

(*b*) *Aetiology*

Incidence

About one case in four occurs in the primigravida. As the relative frequency of primigravidae and multiparae in the population is as 1 to 4, there is no greater liability to accidental haemorrhage in multiparae.

Causation

Trauma

Trauma was formerly believed to play the principal part; it is now believed that it is only rarely a cause, but that prophylactic external cephalic version in breech presentation is responsible for a few cases. There are also well authenticated cases in which the haemorrhage followed directly after a fall or a blow on the abdomen and was apparently due to it.

Torsion of uterus

Torsion of the uterus has been blamed by Morse, but of all the cases in which Caesarean section and necropsies have been performed in concealed accidental haemorrhage torsion has been found only in one case recorded by Glinski, in which the uterus had undergone torsion through 270°, and the placenta had been partly separated by blood-clot.

Vascular hypertension

The chief predisposing factor is vascular hypertension, which precedes the onset of bleeding in a large proportion of cases. This may occur in pre-eclamptic toxaemia, chronic nephritis, or essential hypertension. Portes found toxaemia in 93·3 per cent and eclampsia in 8·3 per cent. The hypertension probably causes the haemorrhage by giving rise to localized spasm in the smaller arteries of the uterus, with consequent injury to the capillary walls beyond, so that they readily give way when the spasm is relaxed and they pass into reactionary engorgement. There are, however, cases in which there has been no preceding hypertension or toxaemia or history of injury. Almost nothing is known about the causation of the haemorrhage in these cases. Perhaps it is due to dietetic deficiency, possibly of vitamin C. James Young believes that pre-eclamptic toxaemia is the result, not the cause, of premature separation of the placenta.

(c) *Morbid Anatomy*

Types of haemorrhage

The haemorrhage may be either concealed, revealed, or mixed. In concealed haemorrhage the blood is retained inside the uterus and forms a clot which lies behind the placenta—retroplacental haemorrhage—and separates it partly or entirely from the wall of the uterus (see Fig. 10); or, rarely, it may lie behind the membranes and only separate them; or it may partly separate both. In revealed haemorrhage the blood escapes from the uterus, as in placenta praevia. Often the haemorrhage is mixed, when the bleeding is partly concealed and partly revealed.

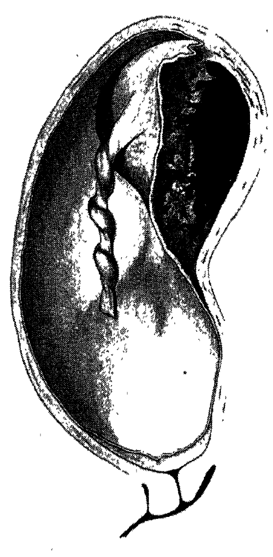

FIG. 10
Concealed accidental haemorrhage (retroplacental haematoma)

Changes in uterine muscle

In 1911 Couvelaire showed that in concealed haemorrhage there was often, in addition to the retroplacental haematoma, extensive extravasation of blood among the muscle-fibres of the uterine wall, especially underneath the placental site. The effused blood dissociates the muscle bundles, and even the individual muscle-fibres, which are often ruptured. In addition the wall of the uterus is oedematous, the oedema fluid being coagulable and albuminous. Couvelaire named the condition *apoplexie utéroplacentaire*, and his observations have since been confirmed. This muscular injury is no doubt the principal cause of the shock that is such an outstanding feature of concealed haemorrhage. Further, it gives rise to an atonic condition of the musculature, so that the uterus is unable to contract and retract normally. This is probably the chief reason why the bleeding is sometimes concealed, and the prognosis is therefore worst in entirely concealed bleeding, because the uterus is completely atonic and the shock most severe. If, on the other hand, the muscle is not extensively injured and can contract and expel the blood or part of

Apoplexie utéro-placentaire

it, and the haemorrhage therefore becomes revealed or mixed, the prognosis is better.

Sites of haemorrhage

The haemorrhage in the uterine wall often shows underneath the peritoneum, subperitoneal ecchymoses or haematomas being present. There may be extensive extravasation of blood in the broad ligament, and in one of my cases blood had tracked from there to the kidney, which was surrounded by a haematoma. The peritoneum covering the uterus may show fissures, which sometimes extend into the muscle beneath. From these fissures extensive bleeding may occur into the peritoneal cavity. Multiple haemorrhages in other organs have been described, e.g. liver, diaphragm, endocardium, meninges, gastric mucosa, and adrenals, and haematuria, haematemesis, epistaxis, and cutaneous ecchymoses. This suggests that the cause of accidental haemorrhage does not affect the uterus alone but all organs and systems of the body, and that the haemorrhage is most marked in the uterus, because in advanced pregnancy it is extremely vascular, with numerous engorged n-walled sinuses in the decidua.

Relation to eclampsia and cortical necrosis of kidney

Eclampsia and pre-eclamptic toxaemia are often associated with accidental haemorrhage. Eclampsism, in which there are eclamptic changes in the liver and kidney without convulsions, sometimes occurs. Bilateral cortical necrosis of the kidney is occasionally associated with concealed haemorrhage, and cases have been recorded in which eclampsia occurred in association with both concealed haemorrhage and bilateral cortical necrosis. The relation between these three conditions has not been finally determined.

(*d*) *Clinical Picture*

Onset

Revealed haemorrhage

Concealed haemorrhage

Pain

Shock

Abdomen

Foetus

In about half the cases the haemorrhage sets in at the ninth month or later. When the haemorrhage is entirely revealed, bleeding is the only symptom apart from those of the pre-eclamptic toxaemia which so often precedes it. In concealed haemorrhage the clinical picture is characteristic. The patient is suddenly seized with faintness and severe abdominal pain, with or without vomiting. The pain is variously described as 'intolerable anguish', 'the greatest torture', 'as if about to burst', 'a distressing feeling of tightness', and 'very violent cramping pains'. It is accompanied and followed by more or less intense shock. The face is pale, the mucous membranes may be so also, and the pulse may be imperceptible. The uterus may be much larger than the period of amenorrhoea would indicate, and on palpation the abdomen is tender and board-like, and no intermittent uterine contractions can be made out. The foetal parts are usually impalpable, and no foetal heart sounds can be heard, the foetus being practically always killed by the extravasation of blood behind the placenta. In most cases the uterus after a time regains its tone, begins to contract, and expels some of the blood or serum *per vaginam*. The bleeding very rarely remains concealed throughout; it only happened once in my 107 cases of accidental haemorrhage.

(*e*) *Course and Prognosis*

In the great majority of instances the bleeding is revealed, comparatively slight in amount, and, with rest and treatment of the underlying toxaemia or hypertension, may not recur, pregnancy then proceeding to term and ending normally. The prognosis is best in the revealed form, there being no shock except that explained by the loss of blood, which may or may not be large. In the entirely concealed type, which is rare, the prognosis is worst, the uterine muscle being much injured and severe shock resulting which may be fatal. The loss of tone in the uterus causes inertia, which predisposes the patient to post-partum haemorrhage, should she survive delivery. In 22 cases collected by Barnes, in 17 the haemorrhage was entirely concealed; 13 died and 4 recovered. In Goodell's collected series of 106 cases of the concealed and mixed types only, 54 mothers died (51 per cent) and only 6 children survived. In all types taken together the mortality is much lower, the majority being cases of revealed haemorrhage. The maternal mortality varies from 3 to 10 per cent and the foetal from 45 to 75 per cent.

(*f*) *Diagnosis and Differential Diagnosis*

Revealed haemorrhage

The revealed type must be distinguished from the unavoidable haemorrhage of placenta praevia (see p. 73). X-rays may be used for this purpose (see p. 77); otherwise a certain diagnosis can only be made by internal examination and exploration of the whole area of the lower uterine segment by the finger inside the uterus (see p. 77).

Concealed and mixed haemorrhages

The diagnosis of the concealed and mixed types is not usually difficult. The hard, tender, and 'woody' abdomen, the shock, and possibly the bleeding from the vagina are characteristic. Obstructed labour may cause a hard and tender uterus, but there are a history and signs of prolonged labour. In one case of mine concealed haemorrhage was closely simulated by a volvulus of the caecum and ascending colon, the diagnosis being made only on laparotomy.

(*g*) *Treatment*

Prophylaxis

This consists in the prevention and treatment of pre-eclamptic toxaemia, chronic nephritis, and hypertension. The most important part of this treatment is rest in the recumbent posture, which is the best means of controlling the hypertension, probably in most cases the immediate cause of accidental haemorrhage.

Curative

All cases should, if possible, be immediately transferred to hospital or an institution giving equal facilities. No vaginal examination should be made beforehand, and the vagina should not be packed. The patient's blood should be grouped on admission and toxaemia treated on the usual lines.

(i) *External or apparent haemorrhage*

Shock is absent.

Mild haemorrhage

Mild haemorrhage should be treated expectantly by rest in bed and sedatives. The patient should be kept in bed for a week or ten days after bleeding has ceased. As the condition cannot usually be diagnosed from placenta praevia, the patient should be kept in hospital till delivery. The cervix should be inspected to exclude cancer and polypus.

Severe or recurrent haemorrhage

Patient not in labour

Patient in labour

Blood transfusion

If the haemorrhage is severe or recurrent, the patient should be examined in the operating theatre as described on page 76, unless placenta praevia can be excluded without vaginal examination. If placenta praevia is excluded and no vaginal examination therefore necessary, the next step depends on whether or not the patient is in labour. If the patient is not in labour, Caesarean section should be ~~perfor~~med. If this is impossible because of unsuitable surroundings or infection, the vaginal pack may be used instead. If the patient is in labour, the membranes should be ruptured, a binder applied, and pitocin, 2 units every half-hour, should be given. If a blood transfusion is necessary, it should be done immediately after Caesarean section, or before delivery if this is taking place *per vias naturales*.

(ii) *Concealed or mixed haemorrhage*

Shock is the outstanding feature.

Patient not in labour

If the patient is not in labour and the os is closed, the shock should be treated by injection of solution of morphine sulphate ¼ grain and hot-water bottles. If the patient is collapsed, glucose saline should be administered *per rectum* and water given freely by mouth. Pulse, blood-pressure, and size of uterus should be watched. When the patient has recovered from shock, pitocin, 2 units every half-hour, should be given till good pains begin, and an abdominal binder should be applied. If bleeding still continues and the uterus is not contracting, Caesarean section is indicated, with or without hysterectomy; but if bleeding continues and the uterus is contracting, the membranes should be ruptured and a binder applied. A blood transfusion, if necessary, should be given after haemorrhage has been controlled, whether by Caesarean section or otherwise.

Pack contra-indicated

No pack should be used in concealed haemorrhage; it increases shock and may cause infection, and thus prejudice chances if Caesarean section has to be performed. Also it is ineffectual, the uterus being atonic.

Patient in labour

If the patient is in labour and the os is dilating, the membranes should be ruptured and a binder applied. Pitocin may be injected if necessary. In all cases toxaemia should be treated if present and post-partum haemorrhage carefully prevented. The value of blood transfusion in all severe cases must be kept in mind.

6.–HYPEREMESIS GRAVIDARUM

(1)—Definition

1296.] Hyperemesis gravidarum is excessive vomiting in pregnancy.

(2)—Aetiology and Pathogenesis

Causation

Little is known of the causation. The condition has been ascribed to stretching of the peritoneum covering the uterus; to disturbed metabolism resulting from disintegration of the endometrium during implantation of the ovum (Munro Kerr); to the demands of the growing ovum for carbohydrate leading to a deficiency of glycogen in the liver; to various endocrine disturbances; and finally to neurosis.

Neurotic factor

Liver necrosis

Toxaemia

Two distinct forms of hyperemesis are usually described: the neurotic and the toxic. The following view of the course of events is more in accord with clinical experience. There is first of all some disturbance, such as one of those already mentioned, which leads to vomiting. This vomiting is likely to be more serious in neurotic women, and in some the neurotic factor may even predominate. If the vomiting, however caused, continues for some time it may lead to serious diminution of the glycogen stores in the liver, which causes liver necrosis (in the centre of the lobule) and fatty degeneration, which will in turn set up a toxaemia, because the damaged liver cannot detoxicate metabolic products as it normally should. An exactly similar necrosis can be produced experimentally by simple starvation, and the tissue regenerates rapidly, if glucose is supplied in ample quantities, provided that the necrosis has not gone too far. The toxaemia is aggravated by dehydration consequent on the vomiting and by constipation. Finally, because of the carbohydrate deprivation fat metabolism is imperfect and acidosis occurs, which in turn may aggravate the vomiting, thus setting up a vicious circle; to break this is one of the chief aims of treatment.

Acidosis

(3)—Clinical Picture and Course

Hyperemesis usually starts as the ordinary morning sickness. Instead of being confined, as at first, to the morning hours it continues throughout the day and occurs apart from taking food. After a time the patient becomes more or less emaciated and apathetic with dry brown tongue and rapid pulse; the bowels are usually constipated; acetone, acetoacetic acid, albumin, and sometimes bile appear in the urine, which is also diminished in quantity with a high specific gravity. Jaundice appears, the temperature may rise, sordes collect on the lips and teeth, and the patient passes into a low muttering delirium ending in coma and death.

Most patients with hyperemesis improve under modern treatment; some few cases end in foetal death and abortion, and then the patients' condition usually becomes rapidly better. Favourable signs are the following: cessation of vomiting, increase in the quantity of urine and a fall in its specific gravity, a slow regular pulse of good volume, a clean, moist tongue, absence of jaundice or of bile in the urine, a blood-pressure not too low (low blood-pressure indicating toxic myocarditis), and a normal temperature. Polyneuritis may set in after recovery but is rare (see p. 115). No permanent damage is suffered by the liver or kidneys, but there is often a tendency to recurrence of the hyperemesis in subsequent pregnancies.

(4)—Differential Diagnosis

Other conditions causing vomiting

Associated vomiting, i.e. vomiting due to some condition accidentally associated with the pregnancy, such as gastric ulcer or cancer, cirrhosis of the liver, tabes dorsalis (gastric crises), cerebral tumour, intestinal obstruction, appendicitis, red degeneration in a fibroid tumour, or an ovarian cyst with twisted pedicle, must be excluded; but perhaps it is commoner to mistake pregnancy vomiting for that due to an associated condition such as gastric ulcer and to treat it as such until too late. It should be remembered that the vomit in hyperemesis gravidarum often contains altered blood, which may lead to a mistaken diagnosis of gastric disease. The blood is probably due to congestion of the stomach wall caused by the continued vomiting. Hyperemesis is sometimes the most outstanding symptom in hydatidiform mole and in acute hydramnios and may be an early symptom of toxic goitre. Encephalitis epidemica too may start with vomiting.

Non-toxic and toxic types

Diagnosis between the non-toxic and toxic types is not always possible, and a case may pass from the first into the second. A diagnosis of toxic vomiting may justly be made if in spite of treatment the vomiting persists and the patient's condition steadily deteriorates. Also if there is jaundice, or bile in the urine, the case is toxic.

(5)—Treatment

Based on the conception of the pathogenesis outlined above, a rational treatment can be formulated of which the following are the essentials: (i) isolation and suggestion to combat any neurotic element present; (ii) the supply of carbohydrates in easily assimilable form, such as lactose or glucose, in order to enable the liver to regenerate quickly and to combat acidosis; (iii) reduction of the strain on the liver and kidneys by diminishing the intake of proteins; (iv) diminution of acidosis by curtailing the intake of fats and increasing carbohydrates; (v) relief of constipation by purgatives and enemas; and (vi) obviation of dehydration and promotion of diuresis by abundant fluids. These are the objects aimed at in the following scheme of dietetic and other treatment.

Mild cases

Diet

In all cases of simple nausea or morning sickness, or those showing occasional vomiting, all meats, soups, fish, chicken, butter, and cream should be avoided for three or four days. Before rising, the patient should eat an apple, banana, or a few crackers. She must eat plenty of fruit, either fresh or stewed, vegetables, salads, bread, toast, crackers, and rusks; she may take jams, jellies, custards, and, sparingly, milk and eggs. The diet should be taken in five small meals throughout the day.

Fluids

Fluid should be given as water, weak tea, and home-made lemonade, to make up a volume of 60 fluid ounces a day.

At the end of three or four days ordinary diet may be resumed if taken in a number of small meals. Fats must be taken sparingly. The bowels must be strictly attended to and aperients (e.g. calomel) administered if necessary.

Moderate cases

Rest in bed and isolation are required. There should be no feeding by mouth, unless the patient feels hungry and asks for food. The bowels should be cleansed by a simple enema each morning. A nutrient enema of 6 to 8 fluid ounces of 10 per cent glucose in saline should be given three times daily, very slowly by a fine catheter. Fluids should be given by mouth up to 60 fluid ounces daily.

On subsidence of symptoms feeding may be started with a little dry toast or crackers. If this is well borne, the next day mashed potatoes and a little jam or jelly with toast may be given. The diet may be increased by the addition of vegetables and fruit, until it resembles that in mild cases. Potassium or sodium bromide, 30 grains, may be added to the night enema if indicated by restlessness.

Severe cases

Rest in bed with isolation is necessary. There should be no feeding by the mouth.

Intravenous glucose

Treatment is as for moderate cases, but 1,000 c.c. of a 5 per cent solution of glucose in saline should be given intravenously *in addition* to the nutrient glucose enemas as above. Glucose may be given intravenously by continuous injection, and this is the best method in the gravest cases. A good method then is to give 5,000 c.c. of 5 per cent solution of glucose in saline at body temperature in forty-eight hours by a cannula inserted into the saphenous vein just over the internal malleolus. Five units of insulin may advantageously be given with it to prevent loss of the sugar in the urine.

Bromide

Potassium bromide up to 60 grains may be added to the night enema.

Calcium gluconate

An intravenous injection of calcium gluconate (10 c.c. of a 10 per cent solution) may with advantage be given every other day to protect the liver against necrotic changes.

Record of progress

In all but mild cases the daily quanity of urine should be measured and recorded. It should be tested daily for bile, albumin, and acetone. Acetone is important if present in large quantities, because it shows severe acidosis. A record should be kept of the daily number of vomits and of the amount of each. Blood-pressure should be recorded. The fundi oculi should be examined at intervals for evidence of haemorrhagic retinitis.

(6)—Indications and Methods for Terminating Pregnancy

Indications

The following should be regarded as indications for terminating pregnancy. (i) No improvement in a severe case after a week or less under treatment as outlined above. (ii) Jaundice, or bile in the urine. Jaundice in vomiting of pregnancy is not always an indication of destruction of liver tissue. It is undoubtedly sometimes a catarrhal jaundice, but clinically the diagnosis between the two is often difficult. Yet the distinction is important, for catarrhal jaundice is not an indication for terminating pregnancy. The general state of the patient must be taken into account. If this is good, the jaundice may properly be regarded as catarrhal, and medical treatment may then be continued. (iii) Persistent albuminuria. (iv) A pulse persistently over 100 or a temperature persistently over 100° F. (v) Persistently low blood-pressure. (vi) Haemorrhagic retinitis.

Abdominal hysterotomy

The best method of terminating pregnancy is abdominal hysterotomy. The patient must be in very good condition before any other method is justifiable.

Anaesthesia

Local anaesthesia with procaine hydrochloride 2 per cent is best, the abdominal wall being infiltrated in layers. After infiltration of the peritoneum minutes should elapse before opening it, to allow the anaesthetic to act and to avoid shock. For the same reason particular care should be taken to avoid dragging on the peritoneum. The uterus should be infiltrated with the anaesthetic before it is incised, and again time should be allowed for the anaesthetic to take effect. If necessary it is better to give a little gas and oxygen than to risk the least shock, which these patients stand badly. Before opening the uterus, pitocin 0·5 c.c. should be injected into its muscle. A small incision is then made on the anterior wall, opening the cavity. The uterus now usually contracts and squeezes the ovum out entire, without the loss of more than a teaspoonful of blood. The wound is then sutured, and it is a good plan to run a pint or more of saline into the abdomen before its closure. This operation causes no shock, and loss of blood is reduced to a minimum.

Post-operative care

After operation the administration of glucose should usually be continued, by whatever route seems best, but in very serious cases always intravenously by the continuous method.

Finally, it must be emphasized that this disease is extremely insidious, that the medical attendant is liable to be deceived by apparent slight improvements from day to day, and that operation should not be delayed too long.

7.–TOXAEMIAS OF LATE PREGNANCY

(1)—Pre-Eclamptic Toxaemia and Eclampsia

(*a*) *Aetiology and Pathogenesis*

1297.] Any satisfactory hypothesis of the origin of pre-eclamptic toxaemia and eclampsia must explain the following facts: (i) eclampsia occurs only in pregnancy or shortly after delivery; (ii) it occurs chiefly in primigravidae (70 per cent); (iii) it may occur and indeed is more frequent in hydatidiform mole, when there is no foetus; (iv) it is four or five times as frequent in multiple as in single pregnancy; (v) it is sometimes associated with concealed accidental haemorrhage; (vi) it is sometimes associated with bilateral cortical necrosis of the kidneys; and (vii) it may set in for the first time after delivery. None of the explanations so far advanced are entirely satisfactory in these respects, but the following are some of the best known.

Hypotheses of causation

The intestinal toxin hypothesis (*Tweedy, 1913*)

Protein poisoning

Toxic protein derivatives normally enter the blood from the intestines but are neutralized by antibodies. During pregnancy the antibodies also have to neutralize products of placental and foetal metabolism and may be insufficient for both purposes, so that protein poisoning results. The treatment by 'low protein diet' is based on this hypothesis.

The placental hypothesis (*Young, 1914*)

Infarction of placenta

Infarction of the placenta occurs for some reason (see Vol. IX, p. 667), and from the dead or infarcted area poisons are absorbed that cause liver necrosis and eclampsia. Most observers, however, hold that the infarction is a result, not the cause, of pre-eclamptic toxaemia and eclampsia.

The water-poisoning hypothesis (*Zangemeister, 1915*)

Water retention

According to this view there is an increased retention of water in the body because of abnormal permeability of the capillaries, which Zangemeister believed to be due to a toxin. Oedema of the brain thus caused renders it anaemic, so that the brain cells are under-nourished, and their consequent irritability leads to convulsions. The rise in blood-pressure is due to increased intracranial pressure, and the oedema of the kidney leads to an 'ischaemic albuminuria' by causing swelling of the kidney within its rigid capsule. In many cases of eclampsia, however, there is no clinical oedema nor even latent oedema demonstrable by an abnormal increase in weight.

The endocrine hypothesis (*Hoffmann and Anselmino, 1931*)

Pituitary secretions

These workers believed that in eclampsia the posterior pituitary produced two of its secretions in excess: an antidiuretic hormone that caused oedema and a pressor substance that caused hypertension. Other workers have failed to confirm their findings (Theobald; Levitt; Hurwitz and Bullock).

Dietetic deficiency hypothesis (*Theobald, 1930*)

Calcium and vitamins A and B_1 deficiency

Theobald advanced the hypothesis that all the major and minor toxaemias of pregnancy were expressions of dietetic deficiency, especially of calcium and vitamins A and B_1. He has supported his view by the antenatal administration of calcium and vitamins A and B to 50 patients, using a like number of controls. Seven in the treated group developed hypertension of 140 mm. or over with or without albuminuria, whereas 17 in the untreated group developed it. Theobald's view is regarded with increasing favour, and the People's League of Health is, at the time of writing, carrying out a large scale clinical experiment on 2,500 women in various antenatal clinics in London hospitals with the same number of controls, in order to test the part played by diet in toxaemia as well as in other conditions connected with pregnancy.

(*b*) *Morbid Anatomy*

General nature of changes

Generally speaking, the changes in the organs are thromboses of capillaries and smaller veins and occasionally of arterials with haemorrhages and necroses in the areas around them.

Liver

The most characteristic changes are in the liver, in which Davidson described three distinct types of lesion: (i) necrosis of the cells of the peripheral zone of the lobule; (ii) wide-spread necrosis of the cells in the central and middle zones; and (iii) only small areas of focal necrosis. Sometimes there are also capillary thromboses, subcapsular haemorrhages, and even haemorrhages in the parenchyma.

Kidney

In the kidneys there is, according to Fahr and Baird and Shaw Dunn, swelling of the endothelium lining the glomerular capillaries with a marked thickening of their basement membrane. This renders the glomeruli ischaemic. Occasionally degeneration of the tubular epithelium is found. Symmetrical cortical necrosis of the kidneys is occasionally associated with eclampsia, but its exact mode of production is not understood.

Central nervous system

In the central nervous system there is often considerable oedema of brain and meninges. Thrombi in capillaries and venules with multiple small haemorrhages and small areas of surrounding softening are common. Sometimes haemorrhage is very extensive, involves the basal ganglia, and is the immediate cause of death.

Heart

The myocardium shows cloudy swelling; and thrombi in the capillaries, small veins, and arterioles are frequent.

Lungs

Catarrhal pneumonia and sometimes abscesses due to inhalation of infected matter are common in the lungs. Haemorrhages are frequent and vary in size from a pea to a cherry, and thrombi are common in capillaries, venules, and arterioles. Syncytial masses sometimes block the veins and were believed by Schmorl to be characteristic of eclampsia. They have, however, been since shown to be present also in normal pregnancy.

(*c*) *Clinical Picture and Diagnosis of Pre-Eclamptic Toxaemia*

Definition and terminology

Pre-eclamptic toxaemia may be defined as a condition occurring in pregnant women, characterized chiefly by a rise in blood-pressure, oedema, and albuminuria and often ending in convulsions (eclampsia).

'Albuminuria of pregnancy'

The term 'pre-eclamptic toxaemia' is used here instead of the older term 'albuminuria of pregnancy', because the latter emphasized unduly a sign, albuminuria, that is not always present and is rarely present at an early stage of the disease. The practitioner watching his patient for the onset of 'albuminuria of pregnancy' not unnaturally expects to find albumin in the urine, whereas the patient may be in imminent danger of eclampsia though the urine is perfectly normal. The use of the newer term may be expected to lead to earlier diagnosis of the disease, at a time when treatment is more likely to be effective in preventing the development of eclampsia.

Clinical picture

Onset

The disease rarely sets in before about the twentieth week and is much more frequent in primigravidae. The first sign is usually a rise in blood-pressure above the normal level of 130 systolic and 70 diastolic. This may precede other signs, such as albuminuria, by some days or weeks. Following it albuminuria and oedema may appear; the oedema usually precedes the albuminuria and first affects the feet and ankles and later the legs, face, hands, and other parts. The albumin may be a mere trace at first but may increase rapidly till the urine becomes solid on being boiled. The oedema and albuminuria usually increase *pari passu.*

Albuminuria and oedema

Oliguria headache, giddiness, vomiting

When oedema and albuminuria become pronounced, other symptoms appear: oliguria, headache, giddiness, and vomiting. Headache is usually frontal or occipital and often very severe. Dimness of sight, diplopia, flashes of light before the eyes, partial loss of consciousness, and possibly epigastric pain may follow. These are serious symptoms and with high blood-pressure usually indicate that the onset of eclamptic convulsions is imminent. The blood-pressure at this stage may be as high as 220/140.

Blood-pressure

Urine

The urine contains, in addition to albumin, casts—hyaline, epithelial, and granular—and, it may be, blood and bile.

Retina and disc

Important changes may occur in the retina. Grace Jones, investigating recently 124 cases of pre-eclamptic toxaemia, found no change in 69, oedema of the disc and retina in 43, and cotton-wool patches and haemorrhages in 5, while 7 showed diffuse retinitis of the albuminuric type. Of 19 cases of eclampsia 5 showed no change, 8 had oedema of the retina and disc, and 6 had cotton-wool patches of exudate and areas of haemorrhage. Cotton-wool patches of exudate and haemorrhages always indicate the necessity for the immediate termination of pregnancy.

Course and prognosis

The disease may progress rapidly to eclampsia. Most patients, however, improve with treatment up to a point, but very rarely indeed do the signs, especially the hypertension and albuminuria, disappear completely before delivery. After delivery one of three events may happen: (i) the patient may completely recover, no trace of the disease remaining and no recurrence taking place in the succeeding pregnancy; (ii) a chronic hypertension may develop; or (iii) it is usually said that chronic nephritis may develop; it is, however, doubtful if this occurs, and it is more than probable that if chronic nephritis is found after delivery it existed before the pregnancy.

Condition of patient after delivery

Residual hypertension and nephritis

There is no doubt that chronic hypertension is often a result of pre-eclamptic toxaemia or eclampsia, but here again it is highly probable that the patient had a familial tendency to the disease, and that it would have developed eventually, even though she had not become pregnant. The incidence of chronic hypertension or chronic nephritis after pre-eclamptic toxaemia is variously estimated as 10 to 50 per cent, whereas after eclampsia it is only about 5 to 30 per cent. The lower incidence after eclampsia is no doubt due to the fact that, if eclampsia develops, the pregnancy is promptly terminated, whereas in pre-eclamptic toxaemia the disease tends to drag on, and thus the action of the noxious influence, whatever it is, is prolonged until permanent injury results to the cardiovascular system. Generally speaking, the longer the disease lasts before delivery, the higher the blood-pressure, the greater the degree of albuminuria, and the older the patient, the more likely are morbid changes to be found. After delivery the behaviour of the blood-pressure and albuminuria is all-important; thus if the blood-pressure falls to a normal level by, say, the third week of the puerperium and albumin disappears from the urine, the prognosis is usually favourable, and the indications are that no chronic lesion remains. This cannot, however, be relied upon entirely, for often when examined six months or so later, such patients show chronic hypertension or chronic nephritis. The ultimate prognosis therefore cannot be settled until six months or a year after delivery. These matters concerning the incidence of residual disease after eclampsia and pre-eclamptic toxaemia cannot be regarded as finally settled, but the reader may refer to the writings of Theobald; Corwin and Herrick; Herrick and Tillman; and Heynemann for further discussion. The great change in the outlook in recent years has been the increased emphasis placed on residual hypertensive cardiovascular disease rather than on chronic nephritis, and on the probable importance of pre-existing disease or familial tendencies to disease as factors in the causation of residual lesions in general.

Incidence

Diagnosis

As a rise of blood-pressure is practically always the earliest sign of pre-eclamptic toxaemia, routine blood-pressure estimations are of the first importance in the care of the expectant mother. Albumin in the urine may be due to the presence of pus from pyelitis, which must therefore be excluded. Diagnosis must also be made from nephritic toxaemia (see p. 103) and essential hypertension (see p. 104). Considerable attention has been paid recently to routine weighings of pregnant women to discover latent oedema, which may be an important premonitory sign. An increase of over 5 pounds in a month may be regarded as a warning of the possible onset of toxaemia. All patients, however, who show an increase of over 5 pounds do not develop toxaemia, even if they are not treated, and, on the other hand, pre-eclamptic toxaemia may set in without any preceding abnormal increase in weight.

Blood-pressure

Albuminuria

Latent oedema

(*d*) *Clinical Picture and Diagnosis of Eclampsia*

Eclamptic fit

The eclamptic fit is practically always preceded by the signs and symptoms of pre-eclamptic toxaemia above described. Especially

Signs of impending convulsions

Stages of the convulsion

important as signs of impending convulsions are severe headaches, giddiness, visual disturbances, vomiting, epigastric pain, and, perhaps most important of all, a sudden rise of blood-pressure, especially if over 160. This is particularly dangerous if accompanied by much oedema. It is usual to describe the eclamptic convulsion in four stages: the premonitory stage, the tonic stage, the clonic stage, and the stage of coma which may last for several hours. Fits may recur during coma or only after an interval of consciousness, or they may never recur at all. Occasionally the fits succeed each other rapidly, and as many as 200 altogether have been recorded.

Time of onset

The eclampsia may be (i) ante-partum (65 per cent), but labour usually comes on when the fits start; (ii) intra-partum (20 per cent), probably precipitated by the rise of blood-pressure in labour; or (iii) post-partum (15 per cent), occurring a few hours after delivery.

Effect on foetus

Effect on mother

Causes of death

The effect on the foetus varies and largely depends on the severity of the fits. If the fits are severe and rapidly recurring, the foetus is apt to die *in utero*. The effect on the mother is also variable. In severe and typical cases the coma, the cyanosis, the swollen face, and often the stertorous breathing are very characteristic. The temperature may rise to 103° F. or more, and the pulse tends to deteriorate. There is usually retention of urine with dribbling incontinence later, and the bowels, though generally constipated, may be also incontinent. During the clonic stage the tongue is apt to be bitten; blood and mucus or vomited matter may be inhaled and cause septic broncho-pneumonia, which is a not uncommon cause of death. Severe and even fatal cerebral haemorrhage may occur and is due probably to the hypertension. The commonest cause of death is heart failure, which is explained partly by the degeneration of the heart-muscle and partly by the increased peripheral resistance due to the hypertension, the hypostatic congestion of the lungs, and the rapidly recurring convulsions.

Course and prognosis

Death-rate

Eclampsia ranks second to puerperal sepsis as a cause of maternal mortality in England and Wales. Of 4,655 maternal deaths investigated by the Departmental Committee on Maternal Mortality and Morbidity of the British Ministry of Health (1928–32) 11·3 per cent were due to eclampsia. Eden in 1922 found that of 2,000 cases reported from various parts of Great Britain the mean death-rate was 22·5 per cent. The following phenomena may be considered to be signs of danger: coma between fits, a pulse above 120, a temperature over 103° F., a number of fits greater than 10, urine that becomes solid on being boiled, the absence of oedema, and a blood-pressure over 200. If a patient exhibits more than two of these danger signals, the case should be classed as severe. The mortality is considerably influenced by the treatment adopted, the best results being obtained by the expectant method with a minimum of operative interference, introduced by the Dublin school and by Stroganoff. The latter introduced his 'prophylactic' method in

Stroganoff's 'prophylactic' method

1897 and by 1929 was able to collect 6,000 cases treated by means of it in various countries with a mortality of 10·4 per cent. In his own clinic the mortality had previously been 22 per cent. More recently still Stroganoff and Davidovitch reported a mortality of 3 per cent in 200 cases treated by a combination of his prophylactic method and treatment with magnesium sulphate. 'I have at present', says Stroganoff, 'formed the opinion that eclampsia is absolutely curable if the improved prophylactic method is properly applied, providing the patient does not enter the hospital in a hopeless condition, and does not develop any fatal diseases complicating the condition.' The foetal mortality in eclampsia is very high—about 50 per cent; this is partly because labour so often comes on prematurely and partly from the lethal influence of the toxaemia and of the convulsions on the foetus.

Foetal mortality

Remote prognosis

The remote prognosis of eclampsia has been already discussed (see p. 96). If a patient has once had eclampsia she is much more liable to develop it again, but only if she has chronic hypertension or chronic nephritis; otherwise the risk is not any greater.

Diagnosis

Eclampsia must be differentiated from hysteria, epilepsy, especially status epilepticus (see p. 117), and strychnine poisoning. The history, the raised blood-pressure, the oedema, and the state of the urine will usually be sufficient to enable a diagnosis to be easily made.

(*e*) *Treatment of Pre-Eclamptic Toxaemia*

The following is the routine treatment for pre-eclamptic toxaemia carried out in the obstetric unit, University College Hospital, London.

All patients with blood-pressure 150/100 or over should be admitted to hospital, especially if there is also oedema.

Mild cases

Patients with blood-pressure under 150/100 and no evident oedema are treated as out-patients. They are instructed to rest as much as possible, not necessarily in bed. A low protein diet, with increased carbohydrates (glucose), plenty of vegetables, fruit, salads, and 1 pint or more of milk daily, is prescribed. If oedema is present, fluid and salt should be restricted, and purgatives such as jalap and salines given. The patient should be examined again in one week.

Severe cases

Patients with a blood-pressure of 150/100 and over, with or without oedema or albuminuria, should rest in bed on a low protein diet with plenty of vegetables, fruit and green-stuff, and 1 pint or more of milk daily; if oedema is present, a salt-free diet should be given and fluids restricted to the quantity of urine passed, but not less than 1 pint daily; carbohydrates (e.g. glucose) should be increased. Purgation (jalap, salines) should be given. Ultra-violet irradiation may reduce blood-pressure. Hot bottles, blankets, and a fire in the room will encourage sweating. The blood-pressure and quantity of urine should be recorded daily, and albumin estimated in a catheter specimen once weekly. The fundus oculi should be examined once or twice weekly.

Pregnancy should usually be terminated if the condition does not become normal in three weeks at most, to prevent chronic hypertension. If the foetus is already viable (thirty-fifth week), pregnancy should be terminated within two weeks.

Pre-eclamptic state

When all the above signs are more severe, and headaches, visual disturbances, vomiting, and epigastric pain are also present, the patient should be completely starved. Glucose water only should be given by mouth. Hot bottles, blankets, brisk purgation, and venesection to 10 to 20 ounces (if the blood-pressure is above 170 mm.) are indicated. If there is not rapid and marked improvement *in a day or two*, pregnancy must be terminated. In urgent cases Caesarean section is best. In less urgent cases induction by bag or by bougies may be performed.

Rest in bed is by far the most potent method of controlling the high blood-pressure. The best index of progress is the behaviour of the blood-pressure, which should be watched very carefully. Another very important index is the amount of albumin. The onset of visual disturbances, such as dimness of sight and diplopia, or of epigastric pain calls for immediate termination of pregnancy. Another very urgent indication is albuminuric retinitis either in the form of white exudate or haemorrhages, but the case should never be allowed to progress so far.

(*f*) *Treatment of Eclampsia*

This is largely based on the following views of Stroganoff: (i) the danger of eclampsia is largely in proportion to the number of fits; (ii) extraneous stimuli (tactile, auditory, visual) have very great importance in the causation of fits; and (iii) if such extraneous stimuli can be prevented or nearly prevented, then fits will not occur, and the patient will usually recover.

General treatment

Position of patient

The patient should be on a labour bed in the semi-prone position; the position should be changed from left to right and right to left every two hours to avoid hypostatic pneumonia. If the patient is unconscious, the head should be so placed that saliva can dribble away, and a rubber wedge should be in readiness for use in every case. Mucus must be wiped from the nose and mouth. The room should be darkened and all noise prevented. During a fit a rubber wedge or other suitable apparatus should be placed between the teeth. Oxygen must be administered after the fit till cyanosis has disappeared. Any disturbance of the patient, e.g. passing a catheter, vaginal examination, and injection of morphine, must be carried out under chloroform anaesthesia. If the patient is conscious, glucose water only should be given by mouth.

Sweating should be encouraged by warm light blankets, a warm room, and hot bottles (carefully guarded) applied especially to the feet and kidneys.

A nurse should be in constant attendance, at least until fits are controlled.

Routine medical treatment

If the patient has recently had a heavy meal, the stomach should be repeatedly washed out, under chloroform anaesthesia, with sodium bicarbonate solution, 60 grains to one pint, until the returned fluid is clear. Two fluid ounces of a saturated solution of magnesium sulphate should be introduced into the stomach through the stomach-tube. Care must be taken in washing out the stomach that none of the stomach contents are inhaled. Stroganoff omits the stomach wash-out entirely as being too disturbing. I only carry it out if the patient has just had a heavy meal.

A soft high rectal tube, $1\frac{1}{2}$ feet long, should be passed under chloroform anaesthesia and the lower bowel washed out until the returned fluid is clear. This will take a long time and will require up to 4 gallons of sodium bicarbonate solution. When the rectal wash-out is complete, paraldehyde 6 fluid drachms in olive oil should be introduced. The ldehyde should be repeated in four hours and again in a further six hours.

Special medical treatment

If the patient is restless, morphine tartrate $\frac{1}{4}$ grain and atropine $\frac{1}{150}$ grain should be administered under chloroform.

If the patient is cyanosed or the blood-pressure 170 mm., venesection should be performed under chloroform anaesthesia, 10 to 20 fluid ounces being removed.

Calcium gluconate 10 c.c. of a 10 per cent solution should be given intravenously daily if the patient is unconscious: if conscious, 15 grains of calcium lactate thrice daily by mouth.

Obstetric treatment

No obstetric treatment is required except: (i) if the os is half dilated, the membranes may be ruptured; (ii) if the cervix is fully dilated and the head well down, forceps extraction may be employed but is not often necessary; (iii) if the eclampsia is of the fulminating type with an undilated cervix, particularly if the child is alive, or if the fits are not controlled in spite of the above treatment, and provided that no other method of rapid delivery is practicable, Caesarean section may be done; (iv) if indicated by some other obstetric complication the appropriate obstetric interference should be adopted; and (v) if labour has not started it must usually be induced within three or four days after fits are controlled, unless the foetus has died. The best method is usually rupture of the membranes. Occasionally, if the patient improves rapidly, it is possible to continue the pregnancy till the child is viable.

Rupture of membranes

Forceps extraction

Caesarean section

Induction of labour

Treatment of eclampsia by magnesium sulphate

Stroganoff and Davidovitch recently reported favourable results from treatment of eclampsia with magnesium sulphate, which apparently increases diuresis, diminishes oedema, causes a fall in blood-pressure, and controls the fits. In 201 cases treated the mortality was 6 (3 per cent), and in 126 of them (67·7 per cent) the convulsions ceased after the first dose. The details are as follows:

Method of administration and dosage

The patient is nursed in a quiet semi-darkened room, with constant observation by a trained nurse. Measures are taken to avoid anything that might disturb or irritate her. In a short time after the fit, or on being admitted to hospital, she is given an injection of 0·015 to 0·02 grams of morphine muriate under light chloroform anaesthesia and is examined. In 30 minutes about 6·0 grams of magnesium sulphate are given subcutaneously (40 c.c. of a 15 per cent w/v solution). One and a half hours later morphine muriate is injected, and after an interval of 3½ hours (5½ hours after the start of the treatment) 6·0 grams of magnesium sulphate are given again if there has been another fit, or 4·0 grams if there has been none. If delivery does not occur, 4·0 grams or 3·0 grams of magnesium sulphate are administered after further intervals of 6 hours, and then of 8 hours, respectively (i.e. 11½ hours and 19 hours after commencement of the treatment). If the fits do not cease, the patient is given the full dose, i.e. 6·0 grams of magnesium sulphate, but not more than 24·0 grams may be given in 24 hours.

Venesection was performed and the membranes were ruptured in each of those cases in which the patient was admitted after having had six fits, or even fewer if they had been very severe. It is of the greatest importance to keep the patient warm, and preferably on her right side, as well as to administer oxygen after a fit and to ensure that the room is well ventilated.

Toxic effects and their treatment

In some cases the injections cause serious toxic effects which may prove fatal—acute cyanosis, feeble pulse, and laboured breathing—therefore an antidote should always be ready at hand. The best is 10 c.c. of a 5 per cent w/v solution of calcium chloride injected intravenously. Another disadvantage is the occasional formation of subcutaneous abscesses at the site of injection.

After delivery a watch must be kept on the behaviour of the blood-pressure, the daily output of urine, and the amount of albumin in an ordinarily voided specimen. At the end of three weeks, or just prior to discharge, a catheter specimen should be obtained for accurate estimation. The bearing of these points on the remote prognosis has been previously discussed.

(2)—Nephritic Toxaemia

Definition

In this condition pregnancy has occurred in a woman who is already, before the pregnancy begins, the subject of chronic glomerulo-nephritis.

Course and prognosis

It is believed that the pregnancy always leads to a fresh exacerbation of the nephritis and thus further shortens the patient's expectation of life. If the nephritis is very mild to start with, the pregnancy may proceed to term with but little disturbance, except perhaps some increase of hypertension or of albuminuria, and with the birth of a living child. In most cases, though, at some period of the pregnancy more serious symptoms arise, indicating an acute or subacute exacerbation of the disease, and albuminuria and oedema become severe and persistent. The renal breakdown, too, occurs earlier in each succeeding pregnancy. Anaemia is usually a prominent feature and does not yield readily to treatment. In about 60 per cent of cases the foetus dies *in utero*. There is a very greatly enhanced liability to develop eclamptic convulsions. This was well shown in a series of forty-three cases reported by Harris, for nine of them developed eclampsia.

Remote prognosis

The remote prognosis in nephritic toxaemia is very bad.

A striking illustration of this is afforded by the figures published by Stander and Peckham (1931), who traced 135 of 260 patients who had chronic nephritis in pregnancy between 1919 and 1929. Of the 260 pregnancies 63 per cent had been allowed to go to term, 19 per cent had terminated prematurely after viability of the child, and 17 per cent had abortions. Of the 135 patients followed up 42·5 per cent were dead, and of the 89 still alive 30 were found to have severe nephritis and 20 moderate but definite kidney damage. More recently Herrick and Tillman write in confirmation of these results: 'In the follow-up period the majority of the patients reveal persistent albuminuria and often hypertension, retinitis, and other evidences of nephritis. The life expectancy is relatively short and death from infection or uraemia is the rule.'

Differential diagnosis

Diagnosis from pre-eclamptic toxaemia

This must be made from pre-eclamptic toxaemia and from essential hypertension. The latter is considered on page 104. The following are the points to be relied on in differentiating pre-eclamptic toxaemia: (i) in nephritic toxaemia the albuminuria and hypertension are discovered early in pregnancy; in pre-eclamptic toxaemia the onset is usually after the twentieth week; (ii) there may be a history of the existence of nephritis before the pregnancy; (iii) albuminuric retinitis strongly suggests chronic nephritis, but is usually found only in advanced cases; its absence does not therefore exclude chronic nephritis; (iv) there is a tendency to nitrogen retention in chronic nephritis, and a blood urea over 40 mgm. per 100 c.c. strongly suggests this disease; and (v) other kidney function tests may show deficiency; a urea concentration below 2 grams per cent strongly suggests chronic nephritis, as also does a urea clearance below 50.

Treatment

Termination of pregnancy

In the interests of the mother the best treatment is to terminate the pregnancy as soon as the condition is diagnosed, with or without sterilization. Not all patients, however, will agree to this course, especially if they are childless and the disease is mild. In such cases the pregnancy may be allowed to continue, but it is always wise to warn the patient's relations of the risk and that the chances that the child will survive are not good. The best management in such cases is the strictest supervision throughout the remainder of the pregnancy, with absolute rest in bed to control the hypertension and albuminuria, a vegetarian diet, high in carbohydrates and containing abundance of fruit, milk, eggs, and butter, with cod-liver or halibut-liver oil and calcium lactate 15 grains twice daily by the mouth. If there is oedema, a salt-free diet and limitation of fluid are indicated. Anaemia should be vigorously treated, but, if it is severe and does not respond well to iron, as often happens, a blood transfusion should be given. Should severe symptoms set in with marked increase of albumin and perhaps oedema with or without rise in blood-pressure, and especially if albuminuric retinitis supervenes, the pregnancy should be terminated at once.

On account of the great frequency of foetal death in nephritic toxaemia the increase in size of the uterus and the sounds of the foetal heart should be frequently examined. At the end of the thirty-sixth week, if all has so far gone favourably, it is generally advisable to carry out Caesarean section. Before the operation is decided on, it is necessary to make sure that the foetus is big enough to have a moderately good chance of survival. It is apt to be small and undernourished for the period of pregnancy and to have very little vitality, probably because of the chronic white infarction of the placenta so commonly present. It is not uncommonly found, for example, that the child at thirty-six weeks weighs less than 4 pounds, instead of 6½ to 7 pounds as it should in a normal pregnancy.

(3)—Essential Hypertension

In this case pregnancy has started in a woman who is already the subject of hypertension.

Course and prognosis

The outlook for the pregnancy is far more favourable than in nephritic toxaemia. Many patients even with fairly high degrees of hypertension go through pregnancy with very little disturbance beyond some increase of blood-pressure and give birth to live children at term. Probably the course of the disease is hastened by the pregnancy. There is a tendency to concealed accidental haemorrhage, which increases with the rise of blood-pressure, but on the whole such an accident is rare. If the blood-pressure rises above 180 systolic and 110–120 diastolic, albuminuria is apt to appear suddenly with oedema, and typical eclampsia may develop (Herrick). The retinal picture is important. The arteries are at first small and spastic and may constrict the veins, but haemorrhages may occur later. The foetal death-rate is much lower than in chronic nephritis —not more than 15 per cent.

Differential diagnosis

Diagnosis from pre-eclamptic and nephritic toxaemias

This must be made from pre-eclamptic toxaemia and from nephritic toxaemia. The following are the chief points to be relied upon. In pre-eclamptic toxaemia the blood-pressure does not usually rise before the twentieth week. In essential hypertension it is elevated from the beginning of pregnancy. The patient may be known to have had hypertension before pregnancy began, perhaps dating from a previous pregnancy. In essential hypertension, albuminuria is absent, and kidney function tests do not reveal any abnormality.

Treatment

There is not the same need to terminate pregnancy as in chronic nephritis, and it is generally possible to carry it on to term. The treatment is similar to that in nephritic toxaemia. The best method of controlling the blood-pressure is rest, in bed if possible, and ensuring freedom from worry. A largely vegetarian diet given in small meals only, with sufficient milk, eggs, green stuffs, and fruit, and perhaps white fish, is indicated. The bowels should be kept freely acting, preferably by salines, and a mixture containing bromide and chloral hydrate may be given twice daily with advantage, the last dose at bedtime. Strong tea and coffee, tobacco, and all alcoholic stimulants should be avoided. Ultra-violet irradiation may be tried three or four times weekly and sometimes seems to be effective in lowering the blood-pressure when other methods fail. It should not be used if there is albuminuria, because it tends to aggravate it. Venesection is rarely necessary, but its value should be kept in mind, especially if the blood-pressure is 180 or over, a dangerously high level. Caesarean section may be considered but is less strongly indicated than in chronic nephritis, and most of these patients go through labour very well and have living, though small, children. After delivery the blood-pressure must be watched in order to assess the remote prognosis. It may be well to avoid further pregnancies.

(4)—Acute Yellow Atrophy of the Liver

Aetiology

Pregnancy seems to predispose to this condition, for 60 per cent of cases occur in pregnant women. It is probable that the glycogen deficiency in the liver during pregnancy causes this predisposition. The cases fall into two groups: (i) those due to certain poisons, such as chloroform (delayed chloroform poisoning), phosphorus, arsenical compounds, and cinchophen and its derivatives; and (ii) an idiopathic group in which the cause is believed to be some toxin with a special affinity for the liver.

For the morbid anatomy see Vol. VIII, p. 106.

Clinical picture

The disease rarely sets in before the fifth month. The patient, previously in good health, is taken ill with headache, giddiness, epigastric pain, and vomiting. Jaundice soon becomes apparent and rapidly deepens. The tongue is dry and coated, and sordes collect on the lips and teeth. The bowels are constipated and the stools clay-coloured. The urine is scanty and contains albumin and bile, and may or may not contain acetone and acetoacetic acid and leucine and tyrosine crystals. The blood-pressure is normal, but the pulse becomes rapid and weak. The temperature is usually subnormal at first but may rise before death. The liver dullness diminishes, and the spleen is enlarged. In the later stages restlessness and twitching are often severe, but coma usually supervenes rapidly and ends in death within a week or less. Sometimes death is preceded by convulsions. The prognosis is extremely bad, but several recoveries have been recorded.

Treatment The patient should at once be given glucose saline intravenously, as advised for severe hyperemesis (see p. 92). Calcium gluconate should be injected intramuscularly or intravenously, 10 c.c. of a 10 per cent solution being given daily. The pregnancy should be terminated as soon as the disease is diagnosed, preferably by Caesarean section under local anaesthesia. Chloroform and ether should both be avoided.

It is necessary to warn against the prolonged administration of chloroform in pregnancy on account of the grave risk of delayed chloroform poisoning. Further, arsenical preparations in the treatment of syphilis in pregnancy should always be used with caution, care being taken to keep the bowels freely acting and treatment being stopped immediately should the slightest evidence of jaundice appear. The value in prophylaxis of calcium and glucose should be borne in mind. In this connexion the work of Minot and Cutler is of great interest. They found that dogs were highly susceptible to carbon tetrachloride poisoning, which rapidly caused extensive liver necrosis and death in convulsions, but that they were immune to the poison if kept for three weeks before its administration on a diet high in calcium and carbohydrate; and, even if convulsions had developed, the intravenous injection of calcium salts brought about rapid recovery.

8.–DISEASES AND DISORDERS OF THE DIGESTIVE SYSTEM IN PREGNANCY

(1)—Appendicitis

Aetiology 1298.] Appendicitis in pregnancy is usually due to recurrence of an old attack, the recurrence being apparently caused by the upward shifting of the appendix with stretching of adhesions that occurs during pregnancy. In a series of 28 cases reported by Baer there was a clear history of repeated attacks before pregnancy in 14.

Clinical picture The clinical picture differs in no respect from appendicitis apart from pregnancy, except that, on account of the upward shifting of the appendix, after the third month the pain is felt at a progressively higher level. Thus, at the sixth month it may be at the level of the iliac crest, and at the eighth or ninth month in the vicinity of the liver. Tenderness is always most marked directly over the appendix, and so may be at a much higher level than McBurney's point.

Mortality rate In non-pregnant women the mortality from acute appendicitis is about 10 per cent. With this the mortality in the pregnant woman compares most unfavourably, and in the series of 486 cases collected by Schmid was 30 per cent. *Causes of high mortality* This appears to be due to several factors: (i) the displacement of the appendix into the upper abdominal cavity, so that general peritonitis is more likely to develop; (ii) delay in diagnosis, largely because there is a tendency to regard pain, nausea, and vomiting as almost normal accompaniments of pregnancy; in fact, the mortality of appendicitis is largely a mortality of delay; and (iii) the risk of premature termination of pregnancy, which probably arises from peritoneal irritation. It occurred in 12 per cent of Schmid's 486 cases. In the more severe cases with gangrene, perforation, or general peritonitis, abortion occurs in about 50 per cent.

Diagnosis

As appendicitis in pregnancy is usually due to recurrence of a previous attack, it is always important to inquire about this. The higher position of the pain and tenderness should be remembered.

Diagnosis from pyelitis gravidarum

The chief difficulty in differential diagnosis is from pyelitis gravidarum. The following points will help to distinguish between them: (i) in pyelitis the tenderness is often localized in the right costo-vertebral angle; (ii) in pyelitis the temperature tends to be higher, and, in proportion to the temperature, the pulse is good, the general condition of the patient being better than in appendicitis; and (iii) examination of a catheter specimen of urine will reveal the presence of pyelitis (see p. 404). Pyelitis and appendicitis, however, may co-exist, and in such cases, if the diagnosis is in doubt, it is usually well to perform laparotomy.

From other conditions

Diagnosis may also be necessary from such conditions as ruptured tubal pregnancy (not very important, for operation is the best treatment in both), cholecystitis, renal colic, ovarian cyst with twisted pedicle, diverticulitis, and intestinal obstruction.

Treatment

The only treatment for appendicitis in pregnancy is operation, which should be undertaken with the least possible delay. A right paramedian incision is best, for it permits free exploration with a minimum of trauma to muscle and uterus. The uterus should be handled as little as possible. Chloroform and ether are better than spinal anaesthesia, because the latter favours the onset of uterine contractions and may thus promote the supervention of premature labour. After operation the patient should be kept under morphine for three or four days.

(2)—Dental Caries

This is liable to be aggravated during pregnancy; hence the saying 'for every child a tooth'. There is abundant experimental evidence that it is chiefly due to the drain by the foetus on the calcium and phosphorus reserves of the mother. To prevent this depletion an adequate supply of calcium and vitamin D, without which calcium cannot be utilized, is essential. An adequate supply of calcium is assured if the diet includes a pint or more of fresh milk daily with cheese, butter, eggs, fresh vegetables, and fruit, while the vitamin D intake can be supplemented by cod-liver or halibut-liver oil (see Vol. I, p. 611). Cleansing of the teeth is also important, especially at night, for probably the process of decay in the decalcified enamel is accelerated by bacteria and by acids formed during the fermentation of carbohydrates in the crevices between the teeth. Decayed teeth should be promptly attended to, especially as they may be a source of autogenous puerperal infection.

Dietetic prophylaxis

(3)—Constipation

This is probably the commonest disorder to which pregnant women are liable and is largely due to restriction of outdoor exercise. A contributory factor may be the diminished tone of the intestine, part of the general diminution of tone of involuntary muscle which appears to be characteristic of pregnancy. It is of the first importance to secure a free motion at least once daily; by far the best time is immediately after breakfast, and an attempt, even if it is not always successful, should be made at that time. In the prevention and cure of constipation proper exercise and diet are more important than drugs (see Vol. III, p. 382).

(4)—Excessive Salivation

Serious degrees of this distressing complaint are very rare. The expectoration may amount to as much as 50 c.c. daily. Partly from loss of fluid and partly because it prevents sleep, the condition may in such cases lead to rapid wasting. The cause is unknown, but it has been attributed to a neurosis, to pregnancy toxaemia, and to ovarian deficiency. Treatment may be in the first instance by astringent mouth-washes, injection of atropine sulphate, or oral administration of tincture of belladonna to the limit of tolerance. Theobald obtained immediate cure in one case by intramuscular injection of 10 c.c. of calcium gluconate solution.

(5)—Acidity or Heartburn

This is very common during pregnancy, fully 60 per cent of patients suffering from it in a greater or less degree. Some cases are associated with deficiency or absence of hydrochloric acid in the gastric juice, which recent studies have shown to be common in pregnancy. These are generally cured by taking 20 minims of dilute hydrochloric acid in water immediately after meals. Other cases show true hyperacidity and are relieved by sipping a small tumblerful of hot water in which a teaspoonful of sodium bicarbonate is dissolved.

In all, special attention should be paid to the diet (see Vol. VII, p. 18).

(6)—Hyperemesis Gravidarum

For hyperemesis gravidarum see p. 90.

(7)—Haemorrhoids

These are partly due to pressure but are no doubt chiefly caused by the increased vascularity of the pelvic organs in pregnancy and the consequent turgescence of the tributaries of the great pelvic veins. They are, however, aggravated by constipation. The bowels should be opened by a mild purgative, such as confection of senna or of sulphur, a teaspoonful of either being taken at bedtime. The piles should be gently bathed with cold water, gall and opium ointment or witch hazel ointment smeared on, and an attempt made to push them back with the finger. In severe cases much relief may be obtained by applying to the piles a piece of soft flannelette soaked in warm castor oil.

(8)—Enteric Fever

Though rare now, sporadic cases still occur occasionally. The organism is often transmitted to the foetus across the placenta and is more likely to be found in its tissues if the child has been born late in the course of the disease. The foetal and cord blood may give positive Widal reactions, due, it is believed, to the formation by the foetus of its own agglutinins rather than to passive transmission from the mother. Pregnancy appears to have no influence on the course of the disease, the mortality being about the same in the pregnant and non-pregnant. The disease, however, causes abortion or premature labour in 60 to 80 per cent of cases. Treatment is the same as in the non-pregnant, and termination of the pregnancy is not indicated.

Transmission to foetus

Cause of abortion

(9)—Gall-Stones and Cholecystitis

Pregnancy seems to predispose to gall-stones and to cholecystitis, probably mainly owing to the increase of cholesterol, but there are probably many other accessory factors, such as atony of the gall-bladder, want of exercise, constipation, limitation of the movements of the diaphragm, and compression of the upper part of the abdomen by tight lacing and of the bile-passages by the enlarging uterus. All these interfere with the drainage of the gall-bladder and lead to stasis and thus to the formation of gall-stones and to infection and cholecystitis.

Causes

The clinical features are the usual ones. The patient is usually a multipara, and often there is a history of previous attacks. The diagnosis must be made from pyelitis, appendicitis, duodenal ulcer, renal colic, and pneumonia. In the puerperium the condition is liable to be confused with puerperal sepsis. There is some tendency to abortion and premature labour.

Clinical picture and diagnosis

Treatment in the first instance should be palliative. Morphine is especially indicated in view of the tendency to miscarriage. Operation should be delayed if possible till after delivery, but the symptoms may be so urgent as not to admit of delay, and then the pregnancy should be disregarded. The patient should be kept under morphine for four days afterwards.

Treatment

9.–DISEASES OF THE CARDIOVASCULAR SYSTEM

(1)—Heart Disease

(*a*) *Aetiology*

1299.] There is usually a history of rheumatism, growing pains, tonsillitis, or chorea. One or more of these was found in 81 of the 100 consecutive cases observed by Kenneth Harris in the Obstetric Unit, University College Hospital, London. The remaining 19 cases gave no history of previous rheumatic fever, chorea, growing pains, or tonsillitis.

(*b*) *Types of Lesion*

Mitral stenosis is by far the commonest form. In University College Hospital the relative frequency was as follows: mitral stenosis 86 per cent; mitral stenosis with aortic regurgitation 10 per cent; aortic regurgitation 1·5 per cent; and paroxysmal tachycardia 2 per cent. Congestive failure was present in 18·2 per cent of these of such degree that there were persistent râles in the chest, enlargement of the liver, oedema, and pulsation of the veins of the neck. Paroxysmal tachycardia, though fairly common at other times and liable to be aggravated at menstruation, is rare in pregnancy. The attacks in those subject to them may cease entirely in pregnancy and reappear in the puerperium.

(*c*) *Clinical Picture*

Many patients with heart disease pass through pregnancy with but little disturbance. There is, however, always the risk that towards the end of pregnancy, when the usually low reserve powers of the heart are called on, signs of congestive failure may appear—dyspnoea on exertion, palpitation, and perhaps precordial pain. There is often too a tendency to bronchitis. In more severe cases these symptoms are aggravated; there may be dyspnoea or orthopnoea, increased pulse-rate while at rest, crepitations at the bases of the lungs, or even some enlargement of the liver, with oedema of the lower extremities and albuminuria; and pulmonary infarction and haemoptysis are not uncommon. These signs of failure may be present before pregnancy starts, may appear for the first time in the early months of pregnancy, or may be delayed till the later weeks.

The incidence of premature labour is high. In the series above referred to it was 16·5 per cent, occurring in 42·9 per cent of those who had congestive failure and in 14·6 per cent of those who had not.

(*d*) *Course and Prognosis*

The course and prognosis depend chiefly on the condition of the heart-muscle at the beginning of pregnancy. Kenneth Harris attached great importance in prognosis to exercise-tolerance and concluded that (i) early break-down of exercise-tolerance in a primigravida is a grave sign, and (ii) in multiparae the experience derived from the previous pregnancies is of great value, since the break-down of exercise-tolerance earlier and earlier in each successive pregnancy is a serious feature.

Hunt, from a study of 156 cases, laid great stress in prognosis on the size of the heart, and concluded as follows: (i) if the heart is not enlarged, patients with mitral stenosis stand pregnancy well, and there is not much additional risk; (ii) if the heart is enlarged the risk is increased, and it does not matter much whether the valvular disease is aortic regurgitation or mitral stenosis, the amount of extra risk depending on the degree of enlargement and the treatment that can be adopted during pregnancy; and (iii) in auricular fibrillation the results are so disastrous that pregnancy should be prohibited.

Should failure set in, the period of pregnancy when it first appears, its severity, and the response to treatment are all important. The earlier in pregnancy failure appears, the less is the reserve force of the heart and the worse the prognosis. Even after pregnancy and labour are safely passed, some permanent heart weakness is often left, as shown by diminished exercise-tolerance compared with that present before pregnancy. Kenneth Harris's follow-up of 100 cases of heart disease with normal rhythm showed that just over 50 per cent of the whole series were worse or dead at the end of four years.

(*e*) *Treatment*

During pregnancy

All cases, no matter what the condition of the heart-muscle, should be carefully watched and the amount of physical strain regulated so that it is well within the patient's capacity. A moderate amount of exercise is beneficial. The patient should be guarded as much as possible against chills, and special attention should be paid to the care of the skin and alimentary canal. Should signs of congestive failure appear, the patient should be put to bed and fluids restricted, but drugs of the digitalis group are not usually satisfactory unless there is fibrillation.

Should signs of failure appear during the early months, the patient should be restored as far as possible by rest and medical treatment, and as a rule it is wise, especially if the break-down has been at all serious, to terminate the pregnancy. It is impossible, however, to do more than lay down a general rule. Each case must be considered on its merits—the nature of the lesion, the degree of failure, the exact time when it sets in, the state of the heart-muscle, and last but not least the wishes of the patient must be given full consideration. There is, however, considerable risk in carrying on the pregnancy, and even when a viable child is obtained it is usually at the expense of a considerable shortening of the mother's expectation of life. Perhaps in no disease complicating pregnancy are constant consultation and co-operation between the physician and obstetrician so essential and of such advantage to the patient. Such co-operation can best be obtained under hospital conditions, and many more beds could be utilized for the care of these patients than are at present available.

Should failure occur in the later months of pregnancy, it is usually best to rely on medical treatment and to allow labour to come on spontaneously. Fortunately such patients tend to go into labour somewhat prematurely, or, at least, not to go beyond term. It is unwise to induce premature labour by instrumental methods which involve the administration of an anaesthetic, but no harm can be done by a medical induction, and this is often advisable. Rupture of the membranes, too, without an anaesthetic is often permissible, especially if the head is well down in the pelvis, because it saves the patient the strain of the last week or ten days of pregnancy. Caesarean section is usually unnecessary, for these patients generally stand labour remarkably well, and the labour is usually easy. Caesarean section should never be undertaken merely to permit sterilization to be carried out at the same time, and if sterilization is considered advisable it is better to carry it out in the puerperium.

Management during labour

The first stage should be conducted much as in normal cases, but the patient should usually be kept in bed. The second stage is a period of dangerous strain, because the rise in blood-pressure during the strong expulsive efforts may lead to acute dilatation of the heart. The patient should usually be on her back, in a semi-recumbent posture. A general anaesthetic should be given, preferably gas and oxygen, but ether is undesirable because of the liability to pulmonary complications. If there is much distress, forceps should be applied as soon as the os is fully dilated and the head in the pelvic cavity. In most cases, however, forceps is unnecessary, and its routine application in the absence of definite indications, such as maternal or foetal distress, should be condemned. The administration of oxygen may give much relief if there is distress or cyanosis. In the third stage it is advisable to allow the placenta plenty of time to separate, and a little post-partum haemorrhage should be encouraged.

Management after labour

It is generally advisable to keep the patient in bed for at least three weeks to allow complete recovery from any congestive failure that has been present. If failure has been slight, breast feeding may be allowed, but it is inadvisable when failure has been considerable. Here again, however, it is impossible to formulate a hard and fast rule. Breast feeding may cause less fatigue than does the preparation of artificial mixtures, and each case must be judged on its merits. If another pregnancy is desired, an interval of two or three years at least should usually be insisted on. If the patient already has two or three children, it is better to advise against another pregnancy, for not only is it likely to damage the heart-muscle still farther and so shorten the expectation of life, but the strain of rearing a large family may seriously deplete the patient's strength.

(2)—Varicose Veins

About 20 per cent of pregnant women suffer from varicose veins. They are much more frequent in multiparae than in primiparae, and certain families seem to be predisposed to them. In their treatment it is important to wear suspenders in place of garters. The patient should spend a good deal of time lying on her back with her feet on a level with the body or even higher and the clothes loosened round her waist. If it is impossible to spare time for prolonged rest, much relief may be quickly obtained by lying flat on a couch and raising the feet with the legs stretched straight out almost at right angles to the trunk and the feet supported on some convenient object. In addition to the foregoing it is often advisable to wear a bandage of elastic webbing, which should be applied in the morning immediately after rising and removed at night.

Within the last few years varicose veins in pregnancy have been successfully treated by injections of 1 to 2 c.c. of a 5 per cent solution of sodium morrhuate. The technique does not differ from that used at other times.

(3)—Phlebitis

This is a rare complication of pregnancy. The patient is usually a multipara, and there is often a history of phlebitis in a previous puerperium, and not infrequently swelling of the leg has persisted in the interval. Again, varicose veins predispose to it, and then the phlebitis is usually in the superficial and visible veins and does not therefore cause much swelling of the leg. It may, however, start for the first time in pregnancy and in an apparently normal patient and affect the iliac, femoral, or saphenous veins, usually of one side. In these cases the cause is often obscure, though anaemia seems to predispose to it, and a septic focus in the teeth, tonsils, intestine, or elsewhere may be suspected. Phlebitis has usually no effect on pregnancy; neither is there any special predisposition to the development of phlegmasia alba dolens in the puerperium. The treatment is rest in bed and immobilization of the limb until all pain and swelling have disappeared. After the acute stage has passed, massage will help to disperse the swelling.

(4)—Purpura Haemorrhagica

This, too, is a rare complication of pregnancy. Rushmore, in 1925, reported one case and could only find forty-seven others recorded. Usually the disease starts in a previously healthy woman about the sixth or seventh month, and is characterized by slight preliminary malaise, headache, and fever, followed by the appearance of petechial spots and ecchymoses all over the body, together with bleeding from the gums, epistaxis, haematemesis, and haemorrhage from the rectum and sometimes from the urinary tract. After a time the patient becomes profoundly anaemic, with fever, weakness, rapid pulse, and dyspnoea, and there may be marked albuminuria and oedema, probably the result of the anaemia, but the blood-pressure is not raised. The child may be born with the disease or develop it shortly after birth. Little is known about the cause, but the blood-platelets are diminished from the normal 300,000 per c.mm. to 5,000 or less. Premature labour often comes on, after which recovery may take place gradually; but even after delivery many patients go downhill, become prostrated and delirious, and die within a few hours or days. It is remarkable that there does not seem to be much tendency to post-partum haemorrhage.

Treatment

Rest is important with nourishing diet, and in view of the similarity of the disease to scurvy antiscorbutics are indicated. Calcium lactate and iron are sometimes effective. Usually, however, blood transfusion is necessary, and it may be repeated. It arrests the disease at least for a time, and, when temporary improvement is obtained, it may be advisable to induce labour. For the child 5 to 10 c.c. of haemoplastin may be tried, or 10 c.c. of the father's blood may be injected beneath the scapula or into the abdominal wall.

10.–DISEASES OF THE NERVOUS SYSTEM

(1)—Chorea Gravidarum

Aetiology

1300.] The aetiology of chorea in childhood has been discussed previously (see Vol. III, p. 205). Chorea gravidarum most often affects women who have suffered from the disease before the pregnancy began —during childhood or adolescence. It is probable that pregnancy in some way lowers resistance, especially that of the central nervous system, to the spread of infection. In other words chorea gravidarum is essentially the same disease as Sydenham's chorea modified in certain respects by its association with pregnancy.

Clinical picture

It occurs most commonly in primigravidae. There is usually a history of chorea in childhood or of chorea and rheumatism combined and sometimes of shock, fright, or some violent emotional disturbance immediately preceding the onset. It is commonest between the ages of 20 and 25 and comparatively rare after 30. The usual time of onset is the third or fourth month, but it may begin in the first month or as late as the ninth. The clinical picture does not differ from that found in the disease apart from pregnancy and may be present in any degree of severity from the most mild to chorea insaniens. There is in the severe types a distinct tendency to premature labour and to foetal death *in utero*. In the series of 646 cases collected by Willson and Preece the pregnancy went to term in 48·5 per cent, was terminated artificially in 26·5 per cent, and ended prematurely and spontaneously in 25 per cent.

Course and prognosis

In the great majority of cases chorea in pregnancy runs a mild course. It may clear up before delivery but more often continues till after labour, when it usually improves rapidly and by the end of the third week of the puerperium has disappeared altogether. Sometimes, however, the movements take several months to disappear; in one of Buist's cases they persisted for three years. On the whole the disease tends to be of a more severe type than chorea apart from pregnancy, and chorea

Mortality

insaniens is more likely to develop. The death-rate is difficult to estimate, because usually only the most serious cases are reported or find their way to hospital, but it is probably under 1 per cent.

The following may be regarded as unfavourable signs: movements sufficiently severe to interfere with feeding or prevent sleep; serious mental derangement; pyrexia over 100° F. and a pulse-rate persistently over 100. The last two should suggest endocarditis, which is always serious and is found in a large proportion of necropsies. Chorea may recur in successive pregnancies or, after missing one or more pregnancies, may reappear in the third or fourth.

Differential diagnosis

Diagnosis must be made from hysteria, habit spasm, Huntington's chorea, and encephalitis epidemica (see p. 117).

Treatment

The general treatment is the same as in chorea apart from pregnancy (see Vol. III, p. 208). Albrecht used serum from a normal pregnant woman in one case with good results after other methods had failed; 20 c.c. of serum were injected in the gluteal region; in twenty-four hours the movements had almost ceased, and the improvement continued.

Termination of pregnancy

Termination of pregnancy is usually unnecessary but should be considered (i) if movements are so violent as to interfere with sleep and feeding in spite of sedatives; (ii) when the pulse is persistently over 100 and the temperature persistently over 100° F.; and (iii) when the mental condition is evidently deteriorating and there is a tendency to delirium. The best method of terminating pregnancy is usually by rupture of the membranes or by bougies. Caesarean section is usually inadvisable on account of the difficulty in nursing the patient afterwards.

(2)—Neuritis

Vitamin deficiency

Neuritis in pregnancy is now generally regarded as a deficiency disease due to deficiency of the antineuritic factor, vitamin B_1, in the diet. It is possible that achlorhydria or a defect in the gastric juice is a predisposing factor.

Lesions in nervous tissue

The peripheral nerves show degenerative changes, and in the spinal cord, especially in the ventral horn, there is swelling of the cells, loss of Nissl substance, and occasionally necrosis.

Clinical picture

Mononeuritis and polyneuritis

Neuritis in its milder forms, such as are manifested by tingling and numbness in the fingers, is fairly common in pregnancy. Severe neuritis is much rarer and may be a mononeuritis or a polyneuritis. The former is the commoner and usually affects the sciatic, intercostal, or trigeminal nerves. Polyneuritis is commonest in women pregnant for the first or second time and is usually a sequel of severe hyperemesis gravidarum, perhaps coming on soon after apparent recovery, but may occur apart from it.

Korsakow's syndrome

There is progressive weakness of muscles, followed by atrophy, usually affecting first the lower extremities, to which it may be confined, or it may spread to the upper limbs. There may be numbness of the skin of the affected limbs, tenderness on deep pressure over the nerve-trunks, and sometimes exquisite pain on putting the nerves on the stretch. Pain is rarely a prominent feature but may sometimes be acute. An acute ascending paralysis of the Landry type has been described; and Korsakow's syndrome, in which the neuritic symptoms are associated with delirium and loss of memory for recent events, but not for those more remote, has been described in over thirty cases.

Course and prognosis

Mortality

In mild cases of neuritis the symptoms are rarely alarming, and recovery is rapid and complete after delivery. The prognosis of polyneuritis is more unfavourable, and though recovery may take place rapidly it is usually slow, even taking two or three years before it is complete. The mortality is high—67 per cent in the twelve cases reported by Plass and Mengert. In fulminating cases death may occur in three or four days after the symptoms start and is generally due to paralysis of the muscles of respiration. The loss of memory of recent events may be permanent.

Prophylaxis

Prophylaxis consists in providing sufficient vitamin B_1 in the pregnant woman's diet; the liability to polyneuritis after hyperemesis should be borne in mind. When polyneuritis is established, treatment is often unsuccessful and always difficult. Vitamin B_1 oncentrates, such as autolysed yeast and marmite, should be given and the diet adjusted to contain a sufficiency of wheat or brown bread, lentils, beans, peas, and eggs. Liver or liver extract may be given to supply the possibly missing factor in the gastric juice, and iron and ammonium citrate should be given in full doses if there is anaemia. If the disease does not respond to treatment, it is usually necessary to terminate pregnancy, and this should certainly be done if it appears to be rapidly progressive, if the optic, vagus, or phrenic nerves are involved, or if signs of Landry's paralysis appear.

Treatment

Vitamin B_1

Indications for termination of pregnancy

(3)—Cramp

Calcium and vitamin deficiency

This is very common in pregnancy. It is generally agreed that it is due to deficiency of calcium and vitamin D which leads to hyperexcitability of the nervous system. Prophylaxis therefore consists in the provision of a sufficiency of calcium-containing foods, especially milk, cheese, and fresh green-stuffs, and of vitamin D in the form either of fresh milk and butter, or cod- or halibut-liver oil. Cramp is best treated by giving calcium lactate 20 grains three times daily and a tablespoonful of cod-liver oil once daily.

Prophylaxis

Cure

(4)—Epilepsy

Effect of pregnancy on fits

The influence of pregnancy on epilepsy is variable. In many cases it has little or no effect on the frequency or severity of the fits. Sometimes they are made worse and they may very rarely even reach the status epilepticus; or again they may cease during pregnancy to reappear in the puerperium; and finally an epilepsy that had been apparently cured for years may reappear in pregnancy or lactation. Nerlinger gave the following figures regarding 92 epileptic women observed in 157 pregnancies. In 28 per cent of the pregnancies the fits ceased entirely during pregnancy; in 8 per cent they were fewer; in 16 per cent attacks occurred, but the frequency before and after pregnancy is not stated; in 11 per cent they were not influenced; and in 36 per cent they became more frequent and more severe.

Effect of epilepsy on pregnancy

There is little tendency to the premature interruption of pregnancy even in the status epilepticus. Nerlinger found that of 153 pregnancies only 3 ended in abortion, and there was not any evidence that the abortions were caused by the fits.

Diagnosis from eclampsia

The diagnosis between status epilepticus and eclampsia may be very difficult or even impossible. The history is always important, of previous epileptic attacks or of the signs of pre-eclamptic toxaemia, and the epileptic attack is often preceded by a cry. Eclampsia usually sets in late in pregnancy, but epilepsy may occur very early. Albuminuria, oedema, and high blood-pressure are usually present in eclampsia but not in epilepsy, and premature interruption of pregnancy is common in eclampsia but rare in the status epilepticus.

Treatment

The treatment of epilepsy in pregnancy does not differ from the treatment at other times (see EPILEPSY, Vol. V, p. 113). There is usually not any justification for terminating the pregnancy. If, however, the fits are becoming much more severe and mental symptoms threatening, or if the patient's life is being endangered, termination is justified without regard to the life of the foetus. The value of terminating pregnancy in status epilepticus is not established. Such cases are best treated in the first instance by medical measures, including paraldehyde *per rectum* in doses of 4 to 6 fluid drachms diluted with olive oil and repeated in four to six hours; sodium amytal may be injected intravenously, and if necessary chloroform may be used cautiously to bring the fits under control.

Status epilepticus

(5)—Disseminated Sclerosis

It is generally believed that this disease is aggravated by pregnancy, but this is certainly not always true. Termination of pregnancy is seldom justified. The patient should rest throughout the pregnancy and for a considerable time after delivery and should be advised to avoid further pregnancies. (See also Vol. IV, p. 205.)

(6)—Encephalitis Epidemica

Course and prognosis

The course of the disease is not modified by pregnancy, and in most cases the pregnancy is not affected by the disease and proceeds to term. In very severe cases, however, labour may come on prematurely, or the foetus may die *in utero*. Transmission of the disease to the foetus is rare but has occurred occasionally, and the foetus may then be stillborn or born alive with encephalitis. If, however, the child is born healthy and signs of encephalitis do not develop in early infancy, there is little likelihood of their appearance later, and there is not any evidence that later mental impairment will become manifest.

Transmission to foetus

Differential diagnosis

Diagnosis must be made from hyperemesis gravidarum, pre-eclamptic toxaemia, and chorea gravidarum. Encephalitis may start with nausea and vomiting but, though there may be albuminuria, there is no oedema, and the blood-pressure is normal. Some cases of encephalitis may begin with a convulsion which may simulate eclampsia, but in eclampsia the fit has nearly always been preceded by signs of pre-eclamptic toxaemia.

Treatment

The pregnancy should be ignored and treatment carried out on the usual lines (see Vol. IV, p. 551). Termination of the pregnancy is not indicated, because the course of the disease and the mortality are not favourably influenced thereby. Pregnancy should be avoided for four years at least after acute encephalitis on account of the tendency of pregnancy to cause the onset of Parkinsonism.

(7)—Paralysis in Pregnancy and Labour

This may be due to fracture of the vertebrae, to pressure of tumours, or to transverse myelitis. Pregnancy usually proceeds normally to term except for the disabilities attributable to the paraplegia, such as retention of urine and cystitis, and labour is painless. The contractions of the uterus are of normal strength and frequency, though there is usually no attempt to use the accessory muscles, and third stage contraction and retraction are not interfered with.

Treatment

Pregnancy in paralysed patients must be managed along the usual lines. There is not any indication for premature termination. Caesarean section at term, possibly followed by sterilization, is often the best treatment, but each case must be judged on its merits.

11.–DISEASES OF THE ENDOCRINE SYSTEM

(1)—Goitre

1301.] For simple goitre and toxic goitre see GOITRE AND OTHER DISEASES OF THE THYROID GLAND, Vol. V, p. 599.

(2)—Diabetes Mellitus

For diabetes mellitus see DIABETES MELLITUS, Vol. III, p. 644.

(3)—Diabetes Insipidus

Aetiology

Recent work by Beattie shows this to be usually due to a lesion in the supra-optic nucleus of the hypothalamus, which has nerve tracts connecting it with the pituicytes in the posterior lobe of the pituitary. Since these pituicytes are the source of the antidiuretic hormone, it is apparent that if they fail to function polyuria will follow. Congenital or acquired syphilis by causing basal meningitis may bring about the same result. The disease may start during a pregnancy and afterwards persist, or it may appear in pregnancy and disappear afterwards, in which event it may be due to the enlargement of the anterior pituitary causing pressure on the posterior lobe.

Treatment

Treatment is largely symptomatic. The polyuria is best controlled by the injection of pituitary extract or pitressin 0·5 c.c. three times daily. If the Wassermann reaction is positive, antisyphilitic treatment should be pushed. Herrick in one case got an apparently permanent cure by withdrawing 5 c.c. of fluid by lumbar puncture. Premature interruption of pregnancy is not indicated (see also Vol. III, p. 639).

12.–PULMONARY TUBERCULOSIS

Effect of pregnancy on tuberculosis

1302.] Pulmonary tuberculosis is nearly always aggravated by childbearing, for, although during the pregnancy a woman often appears to improve in general health and to put on weight in excess of what can be accounted for by the ovum and the enlargement of the organs of generation, in the puerperium she is apt to lose ground, sometimes rather rapidly. It is indeed a not uncommon experience that even when the lesion, during the pregnancy, has seemed to be quiescent and the temperature normal, the lesion flares up in the puerperium, becomes disseminated with swinging temperature, and progresses rapidly to a fatal issue. This is probably connected with the splinting of the lung in pregnancy and its rapid expansion and free movement after delivery. Kerley has shown by radiography that in the later months of pregnancy the right upper lobe is compressed to one-third of its normal size. The commonest site of cavitation in pulmonary tuberculosis is the right upper lobe, and it is obvious that a pregnant patient with a right upper lobe cavity would get selective collapse of her cavity between the fifth and ninth months. After delivery the rapid descent of the diaphragm with full re-expansion of the upper lobe would result in dragging open a partially healed cavity and exacerbating the disease.

Laryngeal involvement

The frequency of laryngeal involvement is well recognized. It may be due to the congestion of the larynx during pregnancy. The prognosis in such cases is extremely bad.

Effect on pregnancy

There is no special tendency to abortion, provided that the disease is of the non-febrile type, but there is a definite tendency to it when the disease runs an acute course. Congenital tuberculosis in the child is rare. It has already been shown (see Vol. IX, p. 661) that the placenta usually prevents the passage of infection from the mother.

Transmission to child

Diagnosis

If the disease is in an early stage it is apt to be overlooked, the poor health and loss of weight being regarded as due to the pregnant state. The acute febrile tuberculosis in the puerperium may be mistaken for puerperal sepsis.

Treatment

The disease should be managed along the usual lines, and sanatorium treatment is usually advisable. Pregnancy is not a contra-indication to artificial pneumothorax. In labour loss of blood should be reduced to a minimum. Nitrous oxide gas and oxygen are better than chloroform or ether, but it may be better still to avoid a general anaesthetic altogether by using a local anaesthetic, with which the perineum is infiltrated. As soon after delivery as possible an artificial pneumothorax is advisable to maintain the immobility of the affected lung and should be repeated at intervals. In the puerperium rest in bed for at least a month is necessary, if possible in the open air; breast feeding should be forbidden, partly for the sake of the mother and partly to avoid contact infection of the child. The general opinion is that apart from contact infection the child is not any more liable to develop tuberculosis than if it had been born of a healthy mother. Further pregnancies should be avoided till the patient is cured and preferably till she has been clinically well with normal temperature and absence of bacilli from the sputum for at least two years.

During labour

The question of terminating pregnancy prematurely has been much

Indications for terminating pregnancy

debated and cannot be said to be finally settled. It is generally agreed that no benefit results from terminating pregnancy after the end of the third month, for the severe operation required is likely to be more harmful than continuation of the pregnancy till term. No conclusive evidence has yet been advanced that termination of pregnancy in the first three months is likely to influence favourably the course of the disease. Indeed there is much evidence that it may be influenced unfavourably, and the risk of this is the greater the more advanced the pregnancy is, and vice versa. Thus, if only one period has been missed, it is possible to terminate pregnancy with little more risk than that attending an ordinary curettage, and evil consequences from shock and haemorrhage are minimal. It is best in all cases to have the opinion of a physician, if possible one who has special experience of pulmonary tuberculosis, and to be guided by his advice.

13.–PYELITIS

This is dealt with on page 416.

14.–TUMOURS COMPLICATING PREGNANCY

(1)—Fibromyomas of the Uterus

Incidence

1303.] The frequency of fibroid tumours of the uterus in pregnancy is about 0·5 per cent. They are hardly ever met with before the age of twenty-five, most of the patients being over thirty-five. They are commonest in primigravidae. If small, they give rise to no symptoms whatever in pregnancy but may sometimes cause abortion or miscarriage.

Tumours above pelvic brim

Tumours in pelvis

Large tumours situated above the pelvic brim may cause considerable discomfort by their mere bulk, but it is remarkable on the whole how well the abdomen accommodates even very large fibroids, so that pressure symptoms from tumours in this situation are rare. Tumours in the pelvis are usually drawn up above the pelvic brim as pregnancy advances, but sometimes this does not occur; then, as the tumour increases in size, it may give rise to serious symptoms due to pressure on the bladder, rectum, or pelvic veins. Such symptoms generally demand immediate operation with removal of the impacted tumour.

Changes in tumour during pregnancy

Fibroids commonly increase in size during pregnancy, partly from oedema of the tumour, which also leads to softening, and partly from hyperplasia of its muscle-fibres. Another common change in fibroids during pregnancy is red degeneration, which commonly gives rise to abdominal pain, not usually very severe.

General symptoms

The temperature may or may not be slightly raised, and one or more of the fibroids are usually tender on pressure. Occasionally the symptoms may be very acute with severe pain, high fever, vomiting, and distension —in fact, all the signs of an acute abdominal crisis.

Diagnosis

In early pregnancy diagnosis may be very difficult. The patient is usually an elderly primigravida. Amenorrhoea is important, and breast signs are often helpful, especially as the patient has seldom been pregnant before. Fibroids may be associated with secretion in the nipples, but they never cause pigmentation, and the cervix is not softened. The pregnant uterus containing fibroids is larger than would be expected from the duration of amenorrhoea, and the surface may be irregular. The Aschheim-Zondek test is invaluable, and after the fourteenth week X-rays may show the foetal skeleton. In the later months there is, as a rule, little difficulty in recognizing the fact of pregnancy, though the fibroids, because of their softening, often become less distinctly palpable at this time; on the other hand, small fibroids, not formerly felt, become, by the stretching of the uterine wall, projected towards the surface and then may be recognizable for the first time.

Treatment

Many cases need no treatment whatever during pregnancy and proceed to term without any disturbance. Red degeneration is the commonest cause of trouble. The symptoms, however, are nearly always mild and respond well to expectant treatment. The patient should be put to bed, the bowels should be kept open, and, if necessary to relieve the pain, a hot-water bottle may be placed on the abdomen, and analgesics, such as aspirin and morphine, may be administered. Usually the symptoms only subside slowly, and the patient must be prepared to stay in bed for five or six weeks. Occasionally the symptoms, starting in early pregnancy, persist in a mild form until delivery. There is no need in these mild cases to resort to either hysterectomy or myomectomy.

Treatment of severe red degeneration

Myomectomy

In the occasional severe case of red degeneration, in which the patient presents all the signs of an acute abdominal emergency, there is usually no choice except immediate laparotomy. Myomectomy should usually be preferred to hysterectomy, especially if the patient is a primigravida or has no living child. The operation is ideal if there is only one fibroid situated superficially. A fibroid shells out easily from the wall of the pregnant uterus, leaving a bleeding bed, which should be obliterated by continuous or mattress catgut-sutures. After myomectomy there is a great tendency to abortion; in order to minimize the risk, it is important to squeeze the uterus as little as possible during the operation and to keep the patient under morphine for a week afterwards.

(2)—Ovarian Tumours

McKerron estimates the frequency of ovarian tumours as 1 in 2,500 pregnancies.

Incidence of types

Site

In McKerron's series of 1,290 collected cases, the tumour was cystic (simple or multilocular, including papillomatous) in 68 per cent and a dermoid in 25 per cent; 2 per cent were solid and 5·2 per cent malignant. The tumour is situated in the true pelvis and above the pelvic brim with about equal frequency.

Complication

By far the commonest complication is twisting of the pedicle, to which there is an increased liability in pregnancy, especially if the cyst lies above the pelvic brim. Rupture of the cyst in pregnancy is rare, apart from torsion and haemorrhage. Haemorrhage into the cyst is usually the result of torsion of the pedicle, and occasionally the blood so distends the cyst as to lead to its rupture. Adhesions between the cyst and surrounding structures are present in about 20 per cent of cases and are probably due to friction setting up a localized peritonitis, but torsion of the pedicle and infection of the cyst may also cause them.

Rate of growth

There is no evidence that ovarian tumours grow more rapidly during pregnancy than at other times.

Clinical picture

Many give rise to no symptoms whatever, their presence being revealed only by routine examination. If, however, the cyst lies above the pelvic brim, it may be large enough to cause discomfort, dyspnoea, and palpitation from abdominal distension. If the tumour lies in the pelvis and is large enough to fill it, it may cause pressure symptoms, such as retention.

Diagnosis

It must first be determined whether or not the patient is pregnant and secondly, if she is pregnant, whether or not there is an ovarian tumour. Ovarian cysts are sometimes associated with secretion in the nipples but do not cause pigmentation. Neither do they cause amenorrhoea, except in the rare instances in which they are bilateral and have destroyed both ovaries. In doubtful cases recourse may be had to the Aschheim-Zondek test and X-rays. Many of the smaller tumours are only discovered on a routine examination of the pelvis, which, in early pregnancy, should never be omitted. If there is a large cyst above the pelvic brim, the abdomen may be larger than it should be for the duration of the amenorrhoea. The symmetrical shape of the abdomen found in normal pregnancy is changed, and there may be a groove separating uterus and tumour. A cyst in the pelvis tends to displace the cervix upwards, forwards, or laterally, and an abnormal position of the cervix should always arouse suspicion of such a complication.

Differential diagnosis

Differential diagnosis is necessary from uterine fibroids, retroverted gravid uterus, hydronephrosis, ascites, and hydramnios.

Ovariotomy in first half of pregnancy

If the tumour is discovered in the first half of pregnancy, it is wise to remove it. Ovariotomy during pregnancy differs but little from the operation carried out at other times. The uterus should be handled as little as possible, lest abortion occur, and special care should be taken in ligating the pedicle, because should abortion take place the ligature is liable to slip. The patient should be kept under morphine for three or four days after the operation.

Treatment during second half of labour

In the second half of pregnancy a tumour lying above the pelvic brim, and not therefore likely to obstruct labour, should be left unless complications arise. Labour should be allowed to take place at term, and the tumour should be removed as early in the puerperium as possible. If the tumour lies in the pelvis, it may also be left, provided that it causes no symptoms. An effort, however, should be made to push it above the pelvic brim, a procedure which is much facilitated by the Trendelenburg position and general anaesthesia, the rectum and bladder having been previously emptied. If this is unsuccessful, Caesarean section followed by ovariotomy should be performed at term.

(3)—Cancer of the Cervix

This is a rare complication of pregnancy, partly because the disease usually occurs in women past child-bearing age and partly because it tends to cause sterility. The incidence is about 1 in 4,000 pregnancies.

About 30 to 40 per cent of the pregnancies end in either abortion or premature labour. It is usually stated that the disease progresses rapidly in pregnancy because of the increased vascularity, but according to Spencer pregnancy has little influence in this respect. The symptoms and diagnosis do not differ from those of cancer of the cervix apart from pregnancy.

Treatment of early cases

For early cases in early pregnancy, either the Wertheim operation or treatment by radium and X-rays should be carried out at once. If radium is adopted, the pregnancy should first be terminated and radium inserted in the second or third week of the puerperium.

For early cases in late pregnancy Caesarean section should be done, followed by radical abdominal hysterectomy, or, if preferred, conservative Caesarean section may be followed by the use of radium and X-rays.

Treatment of advanced cases

In advanced cases in early or late pregnancy, if the growth is septic and sloughing, it may be unsafe to attempt induction of abortion or of labour, and in any case the cervix will probably not dilate. The best treatment in these is Caesarean section followed by sub-total hysterectomy. In that way the easily infected placental site is removed. After recovery from the operation, radium should be applied, followed by deep X-rays. It is an important practical point to observe that, if the uterus has been amputated at the level of the internal os, the cervical canal may be too short to permit the insertion of a radium applicator. The amputation should therefore be carried out some distance above that level, and in deciding the exact level allowance should be made for subsequent involution. The object of the hysterectomy is to remove the placental site, and it is sufficient if the uterus is amputated just below it.

Should the pregnancy be in its early stages, it is well to carry out these procedures without delay. If, however, the foetus is near viability, it is usually advisable to wait until the end of the thirty-sixth week, in order to give the child a good chance of survival.

15.–VENEREAL DISEASES

For gonorrhoea see GONORRHOEA, Vol. VI, p. 25.

For syphilis see NEUROSYPHILIS, Vol. IX, p. 224, and SYPHILIS.

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PREMATURITY

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Reference may also be made to the following titles:

INFANT FEEDING: THE FEEDING OF NORMAL INFANTS AND CHILDREN
MARASMUS

1.–CONDITION OF PREMATURE CHILD AT BIRTH

1304.] The premature child is small and weighs at birth between 3 and 5½ pounds, but infants under one pound at birth have survived. It may be difficult to tell whether a child is premature, because the dates given by the mother are apt to be misleading, but any child whose weight at birth is 5½ pounds or less should be treated as premature irrespective of the gestation period.

The skin is tender and bright red and, owing to the absence of subcutaneous fat, hangs in loose folds. The face is wrinkled and gives the child an old wizened appearance. Lanugo is present on the forehead, sides of the face, and particularly on the shoulders and extensor surfaces of the limbs. The head is large for the size of the child and round; the posterior as well as the anterior fontanelle may be open, and the sutures are easily felt. The nails are short and poorly developed. The child lacks vigour; all its movements are slow and sluggish, and it may be too weak to cry or, if it does so, the cry is very feeble. Its efforts at suction may be very feeble and ineffective. The premature baby sleeps more than the normal child, and it may be difficult to rouse it even for feeds. The temperature is low and irregular; in some cases it is subnormal and can only be registered by a thermometer specially graded for this purpose. The urine is scanty, and the bowels are sluggish. Jaundice occurs in a very high proportion of the premature.

2.–GENERAL MANAGEMENT

Maintenance of body temperature

Loss of heat through radiation is increased owing to the relatively greater skin surface in proportion to the body-weight as compared with a normal child and owing to the absence of subcutaneous fat. Heat regulation is faulty owing to immaturity of the nervous system, and for a similar reason the circulation and cardiac action are feeble. The sufficient intake of food and faulty metabolism are additional factors. During delivery great care should be taken to avoid injury or chilling. The temperature of the room should be kept at 75° to 80° F. The child ould be received in a warm blanket and immediately covered. After the nose and mouth have been cleared, it should rest undisturbed for at least six hours after birth, at the end of which time the skin may be gently oiled. All handling must be of the gentlest in order to maintain energy and warmth. The temperature should be taken *per rectum* from the first at four-hourly intervals with a thermometer registering low temperatures. High temperatures may easily be produced, and much harm is done if the child is overheated, but it must be kept sufficiently warm.

Ventilation

The room must be well ventilated with fresh moving air, but draughts should be rigidly avoided. The air must be sufficiently moist, and to ensure this one or two shallow pans of water may be placed on the floor near the fire or gas heater.

Bathing

Until the child begins to show more signs of vigour the skin should be cleaned with olive oil every second or third day only. The baby should not be bathed until it weighs 4½ to 5 pounds and then only if it is vigorous, the bath being given every other day at first.

Risk of infection and anaemia

The general low state of vitality increases the liability to infections, particularly those which cause catarrh. Whenever possible, the baby should be kept in a room by itself and attended by a nurse or nurses who are free from any kind of catarrhal or septic infection. No one suffering from a cold or cough should be allowed to approach a premature infant. There is an increased liability to nutritional anaemia owing to the diminished storage of iron.

Respiratory system

The respiratory centre is poorly developed, and efforts at respiration are also feeble owing to weakness of the respiratory muscles. Atelectasis, when present, may be another contributory factor.

Nutrition

The sucking and swallowing reflexes are feeble or may be absent, and therefore the intake of food is difficult or inadequate. The immature state of the whole alimentary system renders the digestion and absorption of food very difficult.

Weakness of vessels

The walls of the blood-vessels, especially the intracranial vessels, are weak and therefore liable to damage. Intracranial haemorrhage may cause early death, which is sometimes mistaken for death from respiratory failure owing to pressure on the respiratory centres.

Cradle

The cradle should be lined with porous brown paper covered with a soft blanket in addition to the ordinary bed-clothes. The simplest way of keeping the cot warm is by the use of three rubber hot-water bottles; one bottle at 180° F. is placed at the foot and one at 160° F. on either side of the child, the bottles being covered in flannel. At first the bottles are changed hourly, but later the changing is regulated according to the child's temperature. An electric cradle is convenient for maintaining a constant temperature. The baby's position in its cot must be gently changed before each feed, since it is too feeble to move itself.

Incubators inadvisable

Owing to difficulties of ventilation incubators are neither necessary nor advisable.

Clothing

The clothing must be warm and soft. A binder of crêpe bandage may be used until the cord has separated. A convenient jacket is made by dividing Gamgee tissue and covering one side with gauze; this can be washed from time to time and keeps in place better than the loose strips of wool often used. Then a petticoat open down the back of some soft light material such as nun's veiling or crêpe flannel should be worn, and on top of this a soft woolly coat. The head should be covered with a woollen bonnet. The feet and legs must always be kept warm and should be covered in knitted woollen bootees which come well above the knee. The hands also should be covered in woollen mittens. The napkin should be soft and not too bulky; it need not be pinned until the baby begins to get active. A soft woolly shawl or light blanket should be wrapped over the other clothes.

3.—FEEDING

(1)—General Considerations

Food requirements

After warmth, a sufficient amount of fluid is the most important need. The child requires a daily intake of water inclusive of that contained in the milk amounting to about one-sixth of its body-weight. This amount should not be given at the start, but usually it will be possible to give about one-eighth of the body-weight in total fluids by the fourth day, working up to one-sixth in two weeks. The amount of food and the intervals at which the feeds are given depend on the age, size, and digestive capacity of each individual infant, and it is not possible to lay down definite rules for feeding for at least the first ten days. Three-hourly feeds day and night are usually sufficient, but two-hourly feeds may be necessary for very small weakly infants. The longer intervals should always be aimed at in order to give the stomach time to empty and to allow the child more time for rest. The food requirement of the premature infant is relatively higher than that of the normal child in order that its rate of growth may be more rapid, but the food must only be given in small quantities at first and thereafter very gradually increased. The child can only be expected to approach the normal average weight after a considerable time, and any attempt to hasten the rate of gain in weight by increasing the food is likely to give rise to a digestive upset often attended by the most harmful results. Increases of food must be regulated according to the weight of the infant and its tolerance for food.

Breast milk is the most desirable form of food for the premature baby and in some cases is absolutely essential, because the child cannot be reared on anything else. If breast milk cannot be supplied by the child's mother it must be obtained from a foster mother, and every possible effort must be made to get it.

First day For the first twenty-four hours, whether the baby is to be breast fed or bottle fed, it is advisable to give warm boiled water only or at the most a little 2·5 per cent glucose solution.

(2)—Routine for Breast Feeding

From the second day diluted breast milk is given, a start being made as a rule with a dilution of one part of the milk to two parts of boiled water or 2·5 per cent glucose solution. The dilution is gradually reduced, half-strength milk being given at the end of a week and full-strength breast milk at the end of two to three weeks. This applies to the average premature infant weighing about 3½ pounds at birth, but each case must be treated according to its own special condition.

Table I is given as a general guide:

TABLE I.—Scheme for Feeding a Premature Baby on Breast Milk for First Two Weeks of Life, giving 8 3-hourly Feeds a Day

The amounts are approximate and must be adapted to each baby.

	Amount of Fluid	Strength of Fluid	Example, Baby 3 Pounds		
			Breast Milk Fluid Ounces	Glucose Solution 2½ per cent Fluid Ounces	Total Fluid Ounces
2nd Day	1/24 Body-weight	1 in 3	¾	1½	2¼
5th Day	1/12 ,,	1 in 3	1¼	2½	3¾
8th Day	1/9 ,,	1 in 2	3	3	6
2 weeks	1/6 ,,	Full strength	8	—	8

Increases should be made of ½ ounce of fluid daily, either equal parts of breast milk and glucose solution, or ½ ounce of breast milk and ½ ounce of glucose solution on alternate days.

After two weeks increases are made in accordance with the baby's needs; the amount should be limited to one-sixth of the body-weight till one month, then raised gradually to 50 per cent above the theoretical caloric requirement, 50 Calories being required for every pound of weight: e.g. a 4-pound baby requires 4 × 50 = 200 Calories, which are provided by 10 ounces of breast milk; this amount should be very gradually increased to 15 ounces.

If the child is very feeble and too weak to suck, it must be fed in its cot with a pipette or an oesophageal tube, the latter being particularly useful in some cases. Great care must be taken to avoid over-feeding on account of the immature state of the digestive mechanism. Great damage is easily done by too much or unsuitable food. In order to find out the child's limit of tolerance, it is safest to begin with a small quantity and to increase gradually.

Breast feeding

When the baby is strong enough to suck, it should begin by going to the breast for one feed in the day, the number of breast feeds being gradually increased as it gets stronger. The time at the breast is also increased gradually, beginning with only a few minutes. Since the premature infants is unable to stimulate the breast sufficiently by its suction additional methods must be applied to maintain lactation. The breasts must be emptied at regular three-hourly or four-hourly intervals by expressing or pumping off the milk. If necessary, breast massage and sponging may be used in addition.

(3)—Artificial Feeding

Milk and whey mixture

When artificial feeding is the only means possible, very great care must be taken to give a food that is easily assimilable and requires the least possible digestive effort. No form of artificial food is really satisfactory for premature infants, but the following mixture of suitably modified peptonized milk and whey often gives good results:

Cows' milk (peptonized 45 minutes)	3 fl. ounces
Whey - - - -	3 fl. ounces
Lactose - - - -	2 level tablespoonfuls
Water (boiled) - -	to 10 fl. ounces

Later the fat in the mixture may be gradually raised by addition of a small quantity of 50 per cent cod-liver oil emulsion.

Unsweetened condensed milk

Unsweetened condensed milk, when suitably modified, is usually well tolerated and is very easy to use:

Unsweetened condensed milk -	5 teaspoonfuls
Lactose - - - -	2 level teaspoonfuls
Water - - - -	4 fl. ounces

This mixture may be used in place of the milk and whey mixture and in similar dilutions according to Table II.

The following table shows the dilutions and amounts of the above-mentioned milk mixtures to be used during the first three months:

TABLE II.—Dilutions and Amounts of Milk Mixtures to be used during First Three Months

AGE OF BABY	MODIFIED MILK MIXTURE (OZ.)	GLUCOSE SOLUTION 2·5 PER CENT (OZ.)	NEW MILK (BOILED FOR 10 MINUTES) (OZ.)	DAILY TOTAL OF MILK AND SUGAR MIXTURE (OZ.)	COD-LIVER OIL EMULSION 50 PER CENT OUNCES	COD-LIVER OIL EMULSION 50 PER CENT LEVEL SPOONFULS
4th day	1½	6	—	7½	—	—
5th day	3	6	—	9	—	—
6th day	4	6	—	10	—	—
7th day	6	6	—	12	1/24	¼ teaspoonful
End of						
2nd week	9	5	—	14	1/12	½ teaspoonful
3rd week	12	4	—	16	⅛	¾ teaspoonful
4th week	14½	2	½	17	⅙	1 teaspoonful
5th week	17	—	1	18	5/24	1¼ teaspoonfuls
6th week	18	—	1½	19½	¼	1½ teaspoonfuls
'th week	19	—	1½	20½	⅓	2 teaspoonfuls or 1 dessertspoonful
8th week	20	—	2	22	9/24	2¼ teaspoonfuls
9th week	21	—	2	23	11/24	2¾ teaspoonfuls
10th week	22	—	2½	24½	½	3 teaspoonfuls
11th week	22½	—	2½	25	7/12	3½ teaspoonfuls
12th week	23	—	2½	25½	⅔	1 tablespoonful

The mixture at the beginning should be very weak and the strength increased gradually; more harm is done by over-feeding than by giving too little. The number and character of the stools should be carefully observed as a guide to the suitability of the food given.

Orange juice

After about the third week the bottle-fed child should be given orange juice, 15 drops a day to begin with, gradually increased to three teaspoonfuls by six months.

Iron and thyroid

Regular small doses of one of the iron scale preparations or saccharated ferrous carbonate should be given to guard against nutritional anaemia. Dried thyroid has also been used with good results to increase the general metabolism and to raise the temperature.

Injection of blood

Intramuscular injection of whole blood or transfusion of blood from a suitable donor is beneficial in cases of extreme weakness.

Oxygen

The intranasal administration of oxygen or of oxygen with 5 per cent carbon dioxide should be used when cyanosis is present.

4.–PROBABILITY OF SURVIVAL

The outlook for the premature child depends on its state of vigour and health rather than on its weight. A very small baby, if it is healthy, has a better chance of survival than one which is unhealthy but heavier. The weight at birth is, however, very important, and as a rule the smaller the baby the more difficult the rearing, for children born before the normal period of gestation are, on account of constitutional weakness, more vulnerable than children born at term with their organs fully developed.

The following statistics, although dealing with small numbers, give some indication of the mortality and progress of premature infants who have come under my observation.

St. Thomas's Hospital Lying-in Ward

YEAR	PREMATURE BABIES UNDER 5 POUNDS AT BIRTH	MORTALITY WITHIN THE FIRST 10 DAYS
1927	31	6
1928	23	8
1929	32	6
1930	30	4
1931	34	9
1932	31	9
In six years	181	42

Mortality = 23 per cent

Premature babies of 5 pounds or under at birth admitted to Cromwell House, Highgate, from 1923 to 1933

Total, 192

Died (mortality = 12 per cent)	23
Mentally defective	5
Good condition when last seen	126
Fair ,, ,, ,,	22
Bad ,, ,, ,,	16

Twins, 23 sets
Triplets, 1 set
Average length of stay in hospital 62·6 days.

Causes of death:

'Prematurity': 11 died between ages of 2 days and 3 months.
Infective enteritis: 3 died—1 at 6½ months and 2 at 9½ months.
Marasmus: 4 died between 2 days and 8¾ months.
Bronchitis: 2 died between 4½ months and 8 months.
Convulsions: 1 died at 1½ months.
Intestinal haemorrhage: 1 died at 1 month.
Measles and pneumonia: 1 died at 3¼ years.

Seventy-three of these patients were admitted to hospital with their mothers and were entirely breast fed, and in following them up it was found that when last seen 61 were in good condition, 4 in fair condition, and 8 in bad condition. There were no deaths.

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PRESBYOPIA

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Reference may also be made to the following title:

REFRACTION, PRACTICAL METHODS

1.–DEFINITION

1305.] Presbyopia literally means old man's sight (πρέσβυς, old man; ὤψ, eye). An ocular change undoubtedly affects every person, whatever his refractive error, after the age of forty, slowly increasing thereafter and reaching its maximum about the age of seventy. With advancing age there is a gradual decline of the power of accommodation in all eyes, due to loss of elasticity of the lens, which becomes more rigid and flatter. As a result the near point of distinct vision recedes, and reading becomes increasingly difficult at the usual distance. At about the age of forty the power of accommodation has diminished so much that in an emmetrope near work cannot be performed comfortably without the aid of convex glasses. This phenomenon is usually spoken of as presbyopia. It is not a disease but a physiological condition which affects every eye.

2.–AETIOLOGY

Changes in lens

In the act of accommodation the ciliary muscle contracts, and the elastic capsule of the lens becomes relaxed, allowing the lens to become more globular, thus increasing its refractivity. This is made possible by the plastic state of the lens in youth. As age advances, the lens becomes hard and sclerosed and cannot be easily moulded, because the central part becomes tougher and more compressed than the younger cortex and forms a relatively hard nucleus; more and more of the cortex becomes converted into nucleus; the lens loses its plasticity and responds less and less to the tension of the capsule. This physical change in the lens is responsible for failure of accommodation, which begins as early as the tenth year, at an age when all the functions of the body are developing. Further, it is said that the contractile power of the muscle also declines as age advances, especially in later years. This physiological factor, however, is of secondary importance.

Changes in ciliary muscle

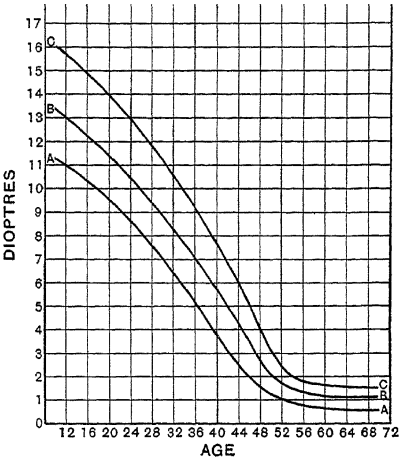

FIG. 11.—Curves showing amplitude of monocular accommodation at different ages. A, lowest physiological limit; B, medium; C, maximal. (From *Text-Book of Ophthalmology*, by E. Fuchs)

Decline and variation in accommodation

How the near point of distinct vision recedes continuously with the gradual decline of accommodation is shown in Fig. 11.

It may be inferred from this table that on the average a normal eye has the following accommodation:

AGE	VALUE IN DIOPTRES	NEAR POINT
10	14	7 cm.
20	10	10 cm.
30	7	14 cm.
40	4·5	22 cm.
45	3·5	28 cm.
50	2·5	40 cm.
60	1	100 cm.

Amount of accommodation necessary

In most persons near work, such as reading and writing, is carried on at a distance of about 25 cm., so that it is necessary to exercise 4 D of accommodation for long periods during the day. The average amplitude of accommodation of an emmetrope at the age of forty-five is about 4 D, so that it is necessary for him to exercise the whole of the accommodation to maintain useful near vision. This effort soon becomes fatiguing, since only a half or two-thirds of this power can be used for any length of time without causing asthenopic symptoms; it seems necessary that at least one-third of the accommodation must be kept in reserve for the sake of comfort. When this limit has been reached and the near point is at a distance of 22 cm., presbyopia may be said to have set in. In the emmetrope this occurs at about the age of forty. Thereafter it is necessary to add a convex lens to his accommodation if near work is to be done without strain.

In emmetrope

In hypermetrope

In a hypermetrope the near point is already farther away than in the emmetrope, and, since the power of accommodation declines in the same degree in both, symptoms of presbyopia will come on earlier, e.g. a hypermetrope with an error of 3 D will need 7 D of accommodation in order to give himself an amplitude of 4 D. He will therefore show symptoms of presbyopia at about twenty-five years of age. In a myope, on the other hand, with an error of 4 D presbyopia will never occur.

In myope

3.–CLINICAL PICTURE

Loss of vision for near objects

The presbyope sees well at a distance but usually has difficulty in maintaining clear vision for near objects. The failure of accommodation as a rule becomes apparent first in reading. Difficulty is chiefly experienced in discerning smaller print, which becomes indistinct, and in order to get within the limits of his receding near point the presbyope pushes his book farther away and holds his head backwards; even with this manœuvre a satisfactorily clear vision is rarely obtained. Reading at night especially becomes troublesome, because the pupils dilate owing to poor illumination, and hence the diffusion circles are larger.

Ocular fatigue and headaches

A feeling of weariness in the eyes after reading, slowly culminating in headaches towards the end of the day, is the chief symptom. The presbyope prefers to read by brilliant illumination or tries to bring the light between the book and his eyes so as to make the pupils contract by allowing a large amount of light to fall upon them. Difficulty is experienced in threading a needle, and sewing becomes increasingly difficult. Finer patterns held before the eyes either fade away or become almost obliterated, and the eyes become fatigued if finer work is persisted in. Asthenopia may occur and probably depends on a disturbance of the balance between accommodation and convergence; the convergence being the same for any given point, a much greater accommodative effort is necessary than was formerly the case.

Asthenopia

4.–TREATMENT

Prescription of convex lenses

Convex glasses must be prescribed for near work, to bring the near point to a comfortable working distance.

This entails (i) determination of the distance at which the individual is going to do his near work; (ii) correction of any error of refraction; (iii) determination of the amplitude of accommodation; and (iv) supplementing the latter with an appropriate strength of lenses, allowing a sufficient reserve of accommodation.

Example. An emmetrope wishes to do his near work at 25 cm. He therefore requires an amplitude of accommodation of 4 D. If his near point has receded to 50 cm., this gives him an amplitude of 2 D only. But it is desirable that he should keep one-third of this in reserve; this leaves him an amplitude of 1·3 D only. Theoretically therefore he requires a lens of 2·7 D to supplement this amplitude, to allow him to work comfortably at a distance of 25 cm. If he has an error of refraction, it should be corrected and he must be rendered emmetropic before his presbyopia is corrected. In any case the accommodation which remains, together with the convex glasses prescribed, must never exceed 4·5 D.

Risk of prescribing too strong a correction

It is a common practice in correcting presbyopia to add to the static refraction one dioptre for every five years over the age of forty. This rule is somewhat arbitrary but within reasonable limits may be practicable; it has, however, led many inexpert surgeons astray. For example, not uncommonly a patient, who cannot read comfortably with his new glasses, is wearing too strong a correction. It is always safer to err on the side of under-correction than over-correction. Presbyopia is a siological condition and liable to individual variations, and depends ot only on the age and refraction of the individual but on his constitution and habits also. The age at which patients are obliged to wear glasses varies and is influenced by the vigour of the individual. A delicate or neurasthenic person will need glasses for reading earlier than a strong and robust individual. Similarly a tall or upright person with long arms will generally require a smaller presbyopic correction than a short person or one who stoops. An average Indian complains of presbyopic symptoms at the age of forty, and some complain even sooner.

Prescribing for special occupations

It is equally important to pay attention to the individual's occupation before prescribing the reading correction. It is also necessary to inquire if he needs glasses for any other special use. Thus in reading, writing, and sewing, 13 inches (33 cm.) is for many a comfortable working distance, but a pianist may prefer a much greater distance (20 to 25 inches), and consequently the glasses that he may need will have to be weaker. It may be necessary to order more than one pair of glasses, e.g. musicians and carpenters may require a separate pair for reading in addition to the pair required for their vocation; in such cases the latter would be weaker than the reading correction.

Difference between twc eyes

The two eyes may not necessarily have the same amplitude of accommodation. The near point of each eye should therefore be determined separately, and a correspondingly stronger glass may be given to the eye with weaker accommodation.

Modificatio for other errors of refraction

The existence of any error of refraction will modify the strength of glasses required for near correction; in all cases therefore the patient's vision for distance and his refraction must be determined. In every case of ametropia the necessary presbyopic correction should be added to the lenses required for distance. This would have the effect of increasing the strength of the convex lens required for presbyopia in cases of hypermetropia and of diminishing its power in myopia. A person aged fifty having hypermetropia of 2 D requires (2 D + Pr. 1·75 D) = 3·75 D for near vision. A myope of 2 D does not require any glasses at the age of fifty, and a person with 4 D of myopia will never need glasses for reading.

Astigmatism

Any astigmatism present must be corrected accurately, and the cylinders should be incorporated with the lenses required for near correction.

Maintenance of balance between convergence and accommodation

In prescribing lenses for the correction of presbyopia care should be taken not to disturb the relationship between convergence and accommodation, and in order to maintain the balance between accommodative effort and convergence a lens of too high a power must not be ordered. This was explained by Fuchs as follows: 'Although a presbyope has only a small amplitude of accommodation available, the effort which his ciliary muscle expends is approximately the same as that employed by a young person with a larger amplitude. The lens of the former is more rigid and not liable to deform in response to the tension of the elastic capsule, and the ciliary muscle may have to contract as much to produce an accommodative change of 1 D in a person of fifty as to alter the dioptric value by 14 D in a child of ten. An individual with only 1 D of accommodation left is able to read at a distance of 33 cm. with suitable glasses. It would seem that he only contracts his ciliary muscle sufficiently to produce the effect of 1 D in the intra-ocular lens, yet it is probable that his effort of contraction of the ciliary muscle is sufficient to add 3 D to the intra-ocular lens, if it were in such a physical state as to respond to such an effort, that is, he contracts his ciliary muscle in accordance with the stimulus set up by the convergence, rather than to accord with the effect on the lens that the convergence is designed to produce.' Stronger glasses should therefore never be prescribed, for fear of upsetting this balance. When they are absolutely necessary, the discomfort is usually relieved by adding to the lens prescribed a prism with the base inwards, or alternatively by decentring the lenses by a corresponding amount. The sphere relieves the accommodation and the prism the convergence.

Necessity for changing glasses

Presbyopia increases with age, and the glasses must be changed for stronger ones every few years. When glasses have to be changed for stronger lenses very frequently, glaucoma should be suspected and the eyes examined carefully for this disease.

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PRICKLY HEAT

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Reference may also be made to the following title:
HYPERIDROSIS

1.–DEFINITION

(*Synonyms.*—Lichen tropicus; miliaria rubra; strophulus infantum; miliaria papulosa et vesiculosa)

1306.] Prickly heat is an acute eruption most commonly seen in tropical countries and consisting of red papules and minute vesicles which are mostly situated around the sweat pores. It is accompanied by intense itching and is very liable to relapse.

2.–AETIOLOGY

Associated fungus

For many years the disease was regarded as purely an affection of the sweat-glands. It is true that imperfectly cornified cells of the horny layer become sodden and swollen by perspiration and so may cause obstruction of the sweat-ducts. This swelling, however, may not be purely physical in origin but might be the result of a local toxin. Since E. C. Smith demonstrated the presence of a yeast-like organism which belongs to the monilia group, most authorities agree that this agent plays an active part in the disease and may well be the source of the toxin which causes the cellular swelling. Sequeira showed that this fungus resembled morphologically the *Pityrosporon malassezia*, which is found in seborrhoeic conditions.

Negroes are never affected, and Pollitzer ingeniously suggested that this freedom could be explained by the fact that their skins were naturally well lubricated with oil, so that the cells became water-proof and did not swell and occlude the ducts. It is most probable that both the physical and mycotic factors play a part in determining the onset.

Relation to climatic conditions

Nearly all Europeans who spend any appreciable length of time in the tropics suffer from this affection at one period or another, particularly during the earlier years of residence. Some unfortunate individuals seem never to become acclimatized and relapse at the onset of every hot season.

3.—CLINICAL PICTURE

The rash

The rash consists of closely aggregated acuminate vesicles and papules. The vesicles are tiny, translucent, and tense, glistening brightly; the papules are equally minute but bright red and are usually more numerous. The lesions always remain discrete. The vesicles are surrounded by a narrow red zone and so contribute to the scarlet appearance; after a few days they become opaque and milky, eventually drying up to form minute scabs. These sheets of eruption may occur anywhere on the body, except on the palms and soles, but are most profuse on the clothed areas, particularly where apposition is most close, e.g. round the waist.

Distribution on body

Aggravating factors

Any action which leads to sweating aggravates the rash and excites an immediate attack of almost intolerable itching and burning. Thus excessive drinking, exposure to the sun, overheated rooms, and heavy clothing all excite an outbreak. The intense irritation leads to scratching, which in turn may result in secondary pyogenic infections. Boils are therefore a common sequel. Although the eruption may be merely annoying in healthy people, the irritation is always so intense that the consequent loss of sleep may have serious effects on children and invalids.

Secondary infection

General disturbances

4.—DIFFERENTIAL DIAGNOSIS

Differential diagnosis need be considered only from acute generalized lichen planus, eczema, and sudamina. There are never any polygonal papules, such as are typical of lichen planus. In prickly heat there is never any discharge as there is in acute vesicular eczema, but there is coexistent copious sweating. These facts, together with the localization of the lesions at the orifices of the sweat-glands, the rapid onset, patchy distribution, and concomitant hot weather, suffice to distinguish the conditions.

5.–TREATMENT

Prevention

It is most essential to avoid or control the exciting causes as far as possible. Clothing should be minimal, and the underwear, which should preferably be of silk, must be frequently changed.

General measures

Diet must be simple and light, alcohol certainly being deleterious. Exercise should be avoided as much as circumstances permit by those subject to the disease and in any case should only be moderate during hot weather. Rooms should be cool, well ventilated, and provided with punkahs. At nights the hollow rattan cylinder known as a 'Dutch wife' will serve to keep the apposed surfaces apart. After the morning bath a grease may be rubbed all over the body, a practice which has proved to be a valuable prophylactic in those liable to repeated attacks.

During an outbreak the above general measures become even more important. The bowels must be kept well open by means of salines, and diuretics, such as potassium nitrate and potassium acetate, are useful.

Local applications

Very many local treatments have been advocated, the simplest of them being evaporating lotions. Weak dilutions of solution of coal-tar or liquor carbonis detergens with lead subacetate or industrial spirit are commonly used. Boulnois recommended a lotion consisting of 3 to 4 per cent solution of formaldehyde and 0·5 per cent of menthol in alcohol or eau-de-Cologne; this may be dabbed on three or four times a day, the patient having been thoroughly bathed and even scrubbed at the beginning of the treatment. Another useful lotion contains 60 grains of salicylic acid in 8 fluid ounces of industrial spirit. Alkaline or bran baths at 90° to 95° F. are soothing; simple dusting powders have their supporters and are certainly easy to apply. Manson recommended the use of medicated soaps and such soaps as afridol or neko (mercurial) or those containing phenol or red mercuric iodide. A lather is produced in warm water and applied to the affected areas, where it is allowed to dry on, only being washed off after fifteen minutes have elapsed.

Medicated soaps

Autohaemotherapy

Wehrle claimed to have obtained most striking results with autohaemotherapy. He gave eight injections in all, starting with 1 c.c. and working up to 4 c.c. of blood, intramuscularly, twice a week.

Change of climate

In the most persistent and severe cases it may become necessary to recommend a change to a more temperate or hill climate; in a few cases sea voyages have proved the only means of cure.

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PROCTITIS

See RECTUM DISEASES, p. 524

PROCTOSCOPY

See ENDOSCOPY OF THE RECTUM, Vol. IV, p. 589

PROGRESSIVE SPINAL MUSCULAR ATROPHY

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Reference may also be made to the following titles:

MYATONIA CONGENITA
NEURITIS

1.–DEFINITION

(*Synonym.*—Werdnig-Hoffmann muscular atrophy)

1307.] This familial malady is characterized by the progressive development of muscular weakness and wasting leading to a fatal issue within a few months. The name Werdnig-Hoffmann disease has been applied to the infantile variety. The essential pathological lesion is a degeneration of ventral-horn cells in the spinal cord.

2.–AETIOLOGY

Onset In some instances the malady appears to have begun before birth, and an unnatural weakness of the new-born infant may be apparent. In other cases it starts during the first year of life, and in a few instances even later in childhood. *Incidence* Sporadic cases have been reported, but usually several siblings are affected. There is no special sex incidence. The sufferers are the children of healthy parents, and inheritance of the disease is exceptional. Its cause is unknown.

3.–MORBID ANATOMY

Intense degenerative changes are seen in the motor nerve-cells of the ventral horns of the cord and of the motor nuclei in the brain-stem. At some levels of the cord these cells may have entirely disappeared. There is some degeneration of motor nerve-roots and of motor nerves. Degenerative changes in the posterior columns of the cord have also been reported. There is intense degeneration of muscle-fibres.

4.–CLINICAL PICTURE

Prenatal cases In the prenatal cases the flaccidity, tonelessness, and undue extensibility of the muscles attract attention after birth. *Postnatal cases* In postnatal cases these features develop progressively within the first months of life. *Muscles affected* The muscles most severely affected are those of the limb girdles and proximal segments of the limbs. The distal limb muscles are stronger and sometimes engage in involuntary contractions which impart slow movements to the hands and fingers. Rapid wasting with some fibrillation ensues, and paralysis is extensive and profound. Later the trunk muscles, then the diaphragm and the muscles supplied from the brain-stem, become paralysed, and death ensues either from respiratory or from bulbar paralysis. The reaction of degeneration is said to be present in the muscles. The tendon-jerks disappear early. The ocular movements remain intact. In cases developing during childhood loss of sphincter control is only a terminal symptom.

5.–COURSE AND PROGNOSIS

In the infantile cases death ensues within the first year of life, whereas in the cases of later onset survival beyond the fifth year is not known.

6.–DIFFERENTIAL DIAGNOSIS

In myatonia congenita there are the same flaccidity and undue extensibility of muscles but less marked loss of power. Further, this loss tends to diminish with the passage of time, and a mild degree of contracture may develop in the muscles of the lower limbs. Some authorities do not recognize the separate identities of these two maladies.

7.–TREATMENT

The course of the malady is uninfluenced by treatment.

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PROPTOSIS

See ENOPHTHALMOS AND EXOPHTHALMOS, Vol. V, p. 43; *and* GOITRE AND OTHER DISEASES OF THE THYROID GLAND, Vol. V, p. 611

PROSTATE DISEASES

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Reference may also be made to the following titles:

CLIMACTERIC AND ITS DISORDERS
GONORRHOEA
REJUVENATION

1.–PROSTATITIS

1308.] Infections usually reach the prostate direct from the urethra, haematogenous infections being a rare complication of parotitis, smallpox, and cellulitis of the neck. Acute prostatitis may occur in a haematogenous infection of the urinary tract by a coliform bacillus (see COLIFORM BACILLUS INFECTIONS, Vol. III, p. 288).

(1)—Acute Prostatitis

(a) *Clinical Picture and Diagnosis*

Early symptoms

The symptoms are the same as those of an acute posterior urethritis: frequent and urgent micturition associated with pain. In the typical acute prostatitis associated with gonorrhoea the onset is sudden and may be heralded by an attack of shivering or by a fully developed rigor (see GONORRHOEA, Vol. VI, p. 10). The temperature rises, and the fever is usually accompanied by thirst, anorexia, and constipation. Deep-seated pain in the perineum extends to the end of the penis and is made worse by standing, sitting, or walking, and by micturition and defaecation. Sometimes the prostatitis causes retention of urine, but when this occurs a prostatic abscess should be suspected. Rectal examination reveals a general enlargement of a firm and exquisitely tender prostate.

Rectal examination

Later stages

The acute stage lasts from a week to a fortnight and is followed by a chronic prostatitis of variable duration. Sometimes resolution fails to occur, and the acute prostatitis passes on to abscess formation. A not uncommon complication is an acute epididymitis due to a descending infection along the lymphatics of the vas deferens.

(b) *Treatment*

All local forms of treatment, such as instrumentation and irrigation, should be stopped at the onset of acute prostatitis. The patient should be confined to bed with hot applications to the perineum and above the pubes. Hot rectal salines, hot baths, and diathermy by means of an electrode in the rectum and one over the pubes (see DIATHERMY, Vol. IV, p. 34) are also helpful. The bowels must be kept open and the patient encouraged to drink the maximum of fluid, such as ordinary water, barley water, Contrexéville, and Vichy. Sandalwood oil in 10-minim capsules and a citrate mixture containing belladonna or hyoscyamus may be given to relieve pain. Analgesics may also be administered in the form of suppositories:

Antipyrin – – – – –	5 grains
Amidopyrine – – – – –	5 grains
Extract of hyoscyamus – – – –	½ grain
Oil of theobroma – – –	to 15 grains

(2)—Prostatic Abscess

(*a*) *Clinical Picture*

Prostatic abscess is usually the sequel to an acute prostatitis and should be suspected when signs and symptoms, instead of diminishing with rest, increase, the pulse-rate rising and the temperature reaching a higher level, associated perhaps with rigors. *Rectal examination* On rectal examination the prostate is found to have increased in size, and deep-seated softening or even fluctuation is discovered.

(*b*) *Course and Prognosis*

Spontaneous rupture

In many cases the abscess ruptures spontaneously into the urethra or, occasionally, into the rectum. Sometimes this rupture follows introduction of a catheter for the relief of retention, the sudden appearance of pus in the urine being followed by a fall in the temperature and a subsidence of symptoms. Occasionally the pus travels downwards to the perineum and forms a tender swelling immediately behind the bulb.

(*c*) *Treatment*

Incision and drainage

If spontaneous rupture into the urethra does not soon occur, or if a swelling appears in the perineum, immediate incision and drainage are necessary. A curved pre-rectal transverse incision is employed. The danger of wounding the rectum must be kept in mind. The abscess is opened by a vertical incision through the sheath of the prostate, and a large rubber drain is inserted and left in position for a week.

(3)—Chronic Prostatitis

(*a*) *Aetiology and Clinical Picture*

Cause

Chronic prostatitis may be the sequel to an acute attack or may begin so insidiously that it causes very few symptoms. It is then often a sequel to a mild infection of the lower urinary tract and is therefore associated with chronic urethritis, stricture, cystitis, and pyelonephritis. In most cases the inflammation is post-gonorrhoeal but due to secondary infections rather than to the gonococcus.

Symptoms

The symptoms may be so slight that they are overlooked or so similar to those of a posterior urethritis that they are indistinguishable from them. *Urinary* They may be conveniently grouped as urinary, nervous, and sexual. The commonest urinary symptom is frequency of micturition with scalding or smarting. *Nervous* The characteristic nervous symptom is aching in the perineum or along the urethra. Occasionally the pain is felt in the groins, in the hips, or over the sacrum. Not uncommonly these symptoms cause neurasthenia. *Sexual* Sexual symptoms consist of pain after coitus, premature ejaculation, loss of sexual desire, priapism, and prostatorrhoea.

Signs

In cases of mild chronic prostatitis the last portion of the urine to be passed is cloudy and contains mucus and threads. A mild albuminuria due to prostatic secretion in the urine exists in many cases. Rectal examination reveals areas of induration and tenderness in the prostate. Sometimes the prostate feels normal, but, on examination of the secretion expressed by massage, pus cells are found. *Rectal examination*

The induration of chronic prostatitis must be distinguished from the hardness caused by tuberculosis, or by malignant disease. In tuberculous prostatitis the indurated area is more likely to be single, harder, and more sharply defined. A malignant nodule is also harder and more discrete. Micturition symptoms are in these cases slight and the urine and prostatic fluid free from pus. *Differential diagnosis*

(b) Prognosis

Unless treated, chronic prostatitis persists for many years with recurrent exacerbations. Epididymitis is a common complication, and in old age urinary difficulties due to fibrosis of the bladder neck may supervene. *Complications*

(c) Treatment

Horse-riding, cycling, and high-speed motoring must be avoided. If a stricture is present it must be treated by dilatation. Local measures consist of posterior irrigation, dilatation, and prostatic massage. The regular passage of large metal instruments, apart from their action on a narrowed canal, assists in expelling the prostatic secretions by stretching the wall of the urethra. Posterior Kohlmann's dilators are of doubtful value owing to the irregular lumen of the posterior urethra and the impossibility of carrying out uniform dilatation. *Dilatation*

Prostatic massage is the most important therapeutic method, the massage lasting five minutes, once or twice a week, and being followed by lavage of the bladder and urethra. A preliminary session of diathermy is helpful (see Vol. IV, p. 34), not only because it relieves pain but also because it increases the amount of secretion obtained at the subsequent massage. *Prostatic massage*

Accessory methods of treatment include the use of suppositories containing ichthammol 3 grains, extract of belladonna ¼ grain, or potassium iodide 5 grains. *Suppositories*

2.–TUBERCULOSIS

(1)—Aetiology and Clinical Picture

Tuberculosis of the prostate is almost always associated with tuberculosis elsewhere in the genito-urinary tract, but it is still debatable whether the direction of invasion is from the prostate to the vesicles or vice versa. Generally the tuberculous process goes on to caseation with rupture of the caseous masses into the urethra or into the bladder, the chief risk in prostatic tuberculosis being involvement of the bladder.

Symptoms may be absent, the tuberculous nodule in the prostate being discovered only during a routine examination. Frequency and *Symptoms*

Urine

pain are the commonest symptoms, but a urethral discharge may be the earliest indication that the prostate is infected. The urine is clear in the early stages, but, when rupture into the urethra or bladder has occurred, it contains pus, tubercle bacilli, debris, and sometimes blood. In the later stages of the disease the infection is generally mixed, and, since the bladder is also invaded, the symptoms are often masked by those of cystitis.

Rectal examination

Rectal examination reveals a tender prostate, with one or two discrete tuberculous nodules imbedded in it. One or both lobes may be affected, and, when a tuberculous collection has ruptured into the urethra, a hollow in the prostate may be palpated.

Diagnosis

The diagnosis rests on the rectal examination and the discovery of tubercle bacilli in the urine.

(2)—Prognosis

Provided that septic complications do not exist, the tuberculous process tends to come to an end, leaving the patient with a fibrosed but prostate. In the presence of septic complications and invasion of the bladder the prognosis is less favourable, but recovery under treatment may still take place.

(3)—Treatment

All instrumentation must, if possible, be avoided. Local instillations of medicaments usually do more harm than good, and the only advisable form of treatment is to place the patient under the best possible hygienic conditions and to give injections of tuberculin. H. H. Young advocated surgical removal of the whole genital tract, including not only the prostate but both vesicles, the vasa deferentia, and the epididymes; the radical operation, however, has not found general favour among surgeons.

3.—SIMPLE ENLARGEMENT

(1)—Aetiology

Nature of enlargement

Opinion has long been divided on the nature of the change that takes place in the prostate in so-called senile enlargement, some having regarded it as an adenoma, others as an inflammation, and yet others as a degenerative process.

Hypotheses of causation

Not only is the exact nature of the enlargement still a matter of opinion, but its causation is equally obscure. All that can be said with any degree of certainty is that these changes in the prostate occur at a certain age—the age, according to some authorities, during which man passes through a kind of climacteric (see CLIMACTERIC AND ITS DISORDERS, Vol. III, p. 232). Yet even this observation is not without exceptions, for I have removed from patients of forty-two and forty-three years of age enlarged prostates indistinguishable from those generally found in elderly men. Moreover the fact that some persons develop a lesion of the prostate at the time of the supposed climacteric does not explain why others escape. None of the supposed predisposing causes—sexual excess, sexual starvation, arteriosclerosis, and past genital infections—is satisfactory, and no satisfactory explanation has been given, but the idea that enlargement of the prostate is associated with some upset in the endocrine balance occurring towards the end of active sexual life is gaining ground.

Endocrinal factors

It has long been known that castration in a young animal prevents the development of the prostate and in older animals brings about its atrophy. It has also been shown by animal experiments that the development of the prostate is influenced by the anterior pituitary, and more recent work by Lacassagne (1933), Burrows and Kennaway (1934), Burrows (1935, b), and Parkes and Zuckerman (1935) has proved that changes in the prostate somewhat similar to those occurring in elderly men are brought about in mice and in monkeys by repeated doses of oestrin. These changes are confined to the posterior lobe of the prostate, which, in rodents, is a separate structure far less intimately associated with the posterior urethra than is the case in man.

Experimental evidence: castration

Oestrin

The support given to the endocrine hypothesis of enlargement has stimulated the performance of operations supposed to increase the output of the internal secretion of the testis, such as vaso-ligature and ligature of the efferent ducts of the testis. Although in some instances these operations appear to have done good, their general efficacy is very doubtful.

(2)—Clinical Picture

The prostate may enlarge slowly for many years without symptoms sufficient to call the patient's attention to his trouble. Perhaps all that is noticeable is a falling off in the power of the stream he passes and a tendency to micturate a little more frequently than before. Indeed, a considerable enlargement may occur without even these symptoms being produced, for no direct relationship exists between the bulk of the prostate and the severity of the symptoms. Moreover the symptoms of prostatic obstruction are irregular, periods of difficulty alternating with times during which the patient is free from all trouble. These variations are probably due to alterations in the state of congestion of the gland and to spasm or relaxation of the sphincters. For the various directions in which the prostate may enlarge see Fig. 12.

Early symptoms

Irregularity of symptoms

As a rule the first symptom is frequency, more particularly at night. Urgency is also an early sign and usually indicates hypertrophy of the bladder wall. A tendency to dribble is also noted, the stream lacking force and showing a disposition to fall away suddenly, so that the patient is never sure whether he has completed the act or will have to return in a few minutes to pass more urine. The difficulty, however, is subject to great variation. It is almost invariably worse after holding the water for some time, in cold weather, or after taking alcohol.

Urinary symptoms

Later, retention may occur, either partial or complete. In still later stages of the disease there is retention with overflow, the patient being unaware that his bladder is distended or else conscious of an increase in the girth of his abdomen. Occasionally retention is the initial symptom to call the patient's attention to the fact that his prostate is enlarged. Usually this unexpected and acute retention is precipitated by some indiscretion, such as an excess of alcohol, or by retaining urine for longer than is comfortable. Haematuria is not usually present unless instrumentation has occurred. Pain is not prominent except as the result of acute retention. Usually the only symptom is a heaviness in the perineum or a slight discomfort over the base of the sacrum.

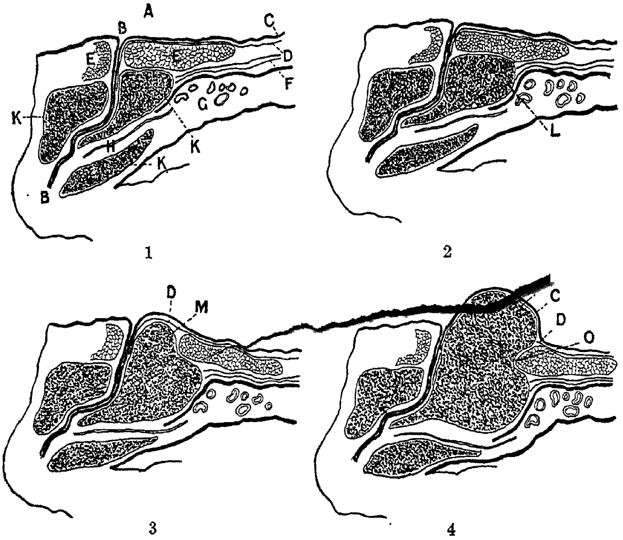

FIG. 12.—Diagrams illustrating enlarged prostate. 1, Antero-posterior section of normal prostate and bladder base. 2, Enlargement of prostate backwards beneath base of bladder. 3, Enlargement of prostate through sphincter. 4, Intravesical enlargement of prostate. A, bladder. B, B, prostatic urethra. C, vesical mucous membrane. D, internal longitudinal layer of bladder muscle. E, E, trigonum muscle and sphincter. F, outer longitudinal layer of bladder muscle. G, seminal vesicle. H, ejaculatory duct. K, K, K, prostate. L, prostate pushing seminal vesicle backwards. M, M, prostate projecting into bladder. O, groove in enlarged prostate from pressure of sphincter. (From *Genito-Urinary Surgery*, by J. Thomson-Walker)

Secondary renal changes

In some cases the patient does not complain of urinary symptoms but seeks medical advice for ill-health resulting from impairment of renal function, such as headache, depression, thirst, and loss of appetite. It is therefore of the utmost importance that an elderly man who complains of these symptoms should be examined carefully for signs of prostatic obstruction. Haemorrhoids, rectal prolapse, and inguinal hernia may all complicate the increased difficulty in micturition.

Urinary infection

When the prostatic obstruction is associated with urinary infection, all the symptoms of the disease are exaggerated. To the difficulty is added pain on micturition as well as all the signs of urinary sepsis. As a result of this combination of retention and sepsis, many complications may arise. These are shown in Fig. 13.

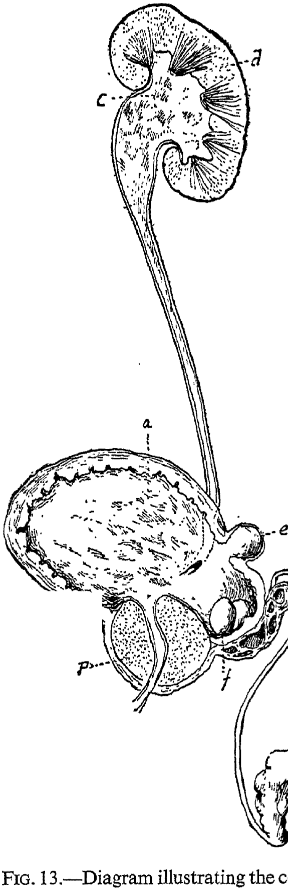

FIG. 13.—Diagram illustrating the common complications of prostatic enlargement. *a*, bladder showing hypertrophy and reticulation; *c*, pyelitis; *d*, pyelonephritis; *e*, bladder diverticulum; *f*, calculi lying in retroprostatic pouch; *g*, epididymitis; *p*, enlarged prostate. (After Legueu. From *The Enlarged Prostate and Prostatic Obstruction*, by Kenneth Walker)

Examinatio of patient

After the general condition of the patient has been noted with special regard to his colour, the state of his tongue, and the absence or presence of renal tenderness or swelling, the abdomen is examined for signs of distension of the bladder. A rectal examination is then carried out and the size of the gland estimated. Its consistence and mobility are also noted, to differentiate an innocent enlargement from a malignant. By bimanual examination, with the patient lying on his back with the knees fully flexed, the mobility of the prostate may be estimated and a rough indication obtained of the amount of residual urine.

Tests of reflexes

The reflexes should also be tested, to eliminate disease of the central nervous system, such as tabes dorsalis, as a cause of difficulty in micturition.

Measureme of residual urine

The residual urine is best estimated by the passage of a catheter after the patient has micturated. All instrumentation in the presence of an enlarged prostate carries with it some danger, not only of haemorrhage, but, what is more serious, of introducing sepsis. The examination should therefore be carried out under the best conditions.

Cystoscopy

In many cases an exact diagnosis can only be made by cystoscopy, because rectal palpation may reveal no enlargement, whereas cystoscopy shows a distinct projection of the gland into the bladder. Cystoscopy is also necessary to exclude such complications as calculus, diverticulum, and tumour of the bladder (see ENDOSCOPY OF THE URINARY TRACT, Vol. V, p. 25).

Tests of kidney function

Finally, the kidneys must be investigated. In the estimation of renal efficiency the following points are important: the total urinary output, the specific gravity of the urine, the percentage of urea, and the presence or absence of albumin, pus cells, and organisms (see URINE EXAMINATION). Renal function tests should also be carried out; the most favoured in this country are the estimation of the blood urea and the urea concentration test, both of which should be carried out.

(3)—Course and Prognosis

In the absence of treatment the condition is progressive, the final stage being retention with overflow. Death occurs from uraemia or from uraemia associated with septic infection of the kidneys. It must, however, be remembered that the symptoms of prostatic enlargement are subject to intervals of improvement, the patient being able to micturate more easily for a time and his frequency diminishing until the next aggravation of symptoms occurs. Although this is the usual sequence of events, a steady progression of the disease is not invariable. Occasionally a patient with early signs of prostatic obstruction may remain *in statu quo* for a number of years and eventually die of some trouble entirely unconnected with his urinary system.

(4)—Differential Diagnosis

Diagnosis from stricture

Difficulty in micturition due to prostatic enlargement usually occurs in men older than those having difficulty from a stricture, and, unless instrumentation has been performed, it is also less likely to be associated with pyuria. All doubts may be set at rest by the passage of a bougie or a catheter.

From malignant enlargement

Malignant disease of the prostate is more likely to start with difficulty of micturition than with frequency. Haemorrhage is also a less common complication in a malignant prostate. On rectal examination, instead of an elastic movable swelling, a hard fixed prostate is discovered with, in more advanced cases, enlarged glands lying above it (see also p. 162).

(5)—Treatment

Treatment of complications

Retention

Retention of urine is dealt with by catheterization. The most rigid precautions should be adopted to avoid infection, and in cases of chronic distension the bladder should never be emptied at a single sitting, for the immediate evacuation of a bladder that has long been distended is likely to be followed by bleeding or by uraemia. It is believed that both of these accidents are the result of the sudden reduction of an increased intrapelvic pressure.

Haemorrhage

Haemorrhage is not usually a serious complication of prostatic enlargement and will generally yield to rest and irrigation of the bladder with hot silver nitrate solution, 1 in 10,000. If the haemorrhage is severe and persistent, suprapubic cystotomy may be necessary.

Sepsis

The treatment of cystitis in the presence of residual urine is likely to be ineffectual, and vesical drainage and lavage through an in-dwelling catheter or a suprapubic tube is therefore generally necessary.

General treatment

In the earlier stages of enlargement, before much obstruction exists, only general treatment is required. The key-note of the patient's life should be moderation in all things. Too much exercise must be avoided and alcohol reduced to a minimum. Sexual activity, if it occurs, must be moderate; if it has been found from experience to increase symptoms, intercourse should be entirely eliminated. Great benefit often results from attention to the bowels and the use of an occasional cathartic even in those in whom no real constipation exists. The patient should avoid putting himself in a situation in which it is necessary to hold urine longer than is comfortable, since a voluntary retention may be followed by one that is involuntary. Attempts have recently been made to treat enlargement by means of endocrine therapy. On the basis of the experimental production of prostatic hyperplasia by the administration of oestrin (see p. 151), the use of the male hormones—testosterone, androsterone, hombreol—has been reported as beneficial (van Cappellen); but it is too early yet to state whether this has any effect. Another method of hormonal treatment is the Steinach operation of vaso-ligature (see p. 579); the rationale of this operation is the idea that prostatic enlargement follows an underaction of the gonads and an overaction of the anterior lobe of the pituitary. This operation, although much advertised abroad, has not been looked upon favourably by British urologists.

X-rays and electro-therapy

Electrotherapy, either X-rays, diathermy, galvanism, or static electricity, has not had much success. Sometimes the frequency is relieved by X-rays, but the improvement in symptoms is not usually associated with reduction in the size of the prostate.

Prostatectomy

This may be either complete or partial—removal only of that portion of the gland that is causing the obstruction.

Freyer operation

Various techniques of suprapubic prostatectomy are adopted in Great Britain by different surgeons, but they are all modifications of the method advocated by Freyer in 1901. The prostate is approached through the bladder by means of a suprapubic incision and enucleated from its capsule by digital manipulation. The aims of the various modifications of the original Freyer technique are to secure better haemostasis, to reduce sepsis, and to avoid such complications as post-prostatectomy obstruction and epididymitis. In the Freyer operation the only measure adopted to combat haemorrhage is irrigation with hot lotions, but modern operators employ packing, various forms of haemostatic bag, ligature, and suturing. These improved haemostatic methods have undoubtedly reduced the amount of post-operative haemorrhage and, since a copious loss of blood predisposes to sepsis, of subsequent infection.

Thomson-Walker's and Harris's operations

Another advance in technique was the introduction by Thomson-Walker in 1929 of an open operation and more recently the employment in suitable cases of Harris's operation with reconstruction of the bladder base and primary closure of the bladder. By using a long incision and introducing a good bladder retractor (see Fig. 14) with the patient in an exaggerated Trendelenburg position, the whole field of operation can be brought under visual control. This allows bleeding points to be ligatured, torn shreds of mucous membrane to be removed, and any fragments of gland inadvertently left behind after enucleation to be excised. In the Harris technique this toilet of the prostatic bed is followed by the introduction of sutures, one of which carries down a tongue of mucous membrane from the trigonum into the depth of the prostatic capsule. Two side-to-side sutures reduce the size of the cavity left by the enucleation and at the same time improve haemostasis. With the complete Harris technique, primary suture of the bladder is carried out, reliance being placed for drainage on an in-dwelling urethral catheter.

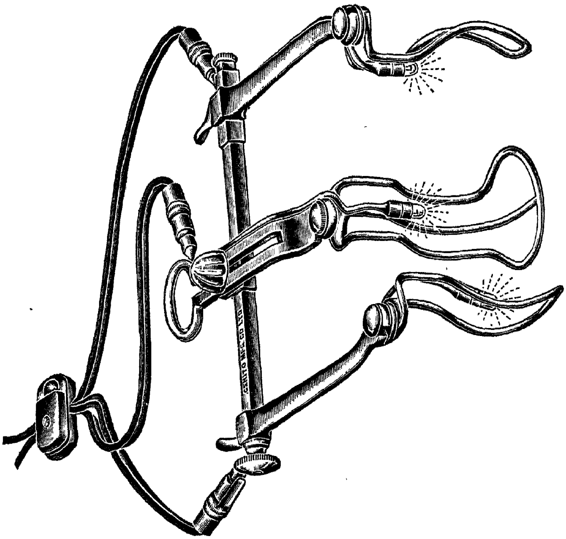

FIG. 14.—Morson's illuminated bladder retractor

Pre-operative treatment

Pre- and post-operative treatment are of paramount importance, and since prostatectomy is not an operation of emergency, there should be plenty of time for a careful preparation of the patient before operation. Only in very exceptional circumstances, namely, when haemorrhage continues from an enlarged prostate even after retention has been relieved by bladder drainage, is it necessary to hasten enucleation. In all other cases much is to be gained by careful and sometimes prolonged pre-operative treatment. Perhaps the most important pre-operative measure

Test of renal function

is the investigation of the renal function. Uraemia is the commonest cause of death, and recognition of the importance of pre-operative treatment of the kidneys has been the greatest advance in prostatic surgery of the last twenty years. Should the clinical condition of the patient and the renal function tests suggest renal impairment, prolonged drainage of the bladder may be necessary, either by means of an indwelling catheter or by a preliminary cystotomy. Which method is selected depends on how long drainage is required. If after ten days of catheter drainage the renal function is not satisfactory, a two-stage prostatectomy is usually indicated. In some cases three or four months' drainage may be required before the risk of prostatectomy is justified. If some form of self-retaining catheter has been inserted, the patient can get about without great inconvenience while wearing his tube. A preliminary drainage should also be insisted upon in infected cases, the bladder being washed out two or three times a day through the suprapubic tube.

Post-operative treatment

Post-operative treatment may be considered under the heading of the various complications that may arise during convalescence.

Haemorrhage

Haemorrhage may be reactionary or secondary during the period of separation of sloughs some eight to ten days after the operation. It is treated by keeping the patient as quiet as possible, if necessary under morphine or opium, and by washing out the bladder with a hot solution of silver nitrate, 1 in 10,000. If this is not sufficient, it may be necessary to pack the prostatic cavity or to insert a haemostatic bag. In all severe cases a blood transfusion should be given (see Vol. II, p. 536).

Sepsis

Sepsis is combated by frequent bladder irrigation, by the copious ingestion of fluids, and, when a Hamilton-Irving box is employed, by keeping a small bag of crystals of boric acid within the box so that the wound is continually bathed with antiseptic. Sepsis is always more severe when shreds of tissue have been left behind in the field of operation and is therefore less likely when the open operation has been carried out.

Epididymitis

The incidence of epididymitis has been considerably reduced by the practice of ligaturing and dividing the vasa at the time of operation. Should it occur, the testes must be raised and heat applied, e.g. poultices and fomentations.

Uraemia

Pre-operative treatment is the most important means of avoiding uraemia. Should signs of uraemia supervene in spite of careful preparation, fluids must be pushed, either by the mouth or by the rectum, subcutaneously, or intravenously. Continuous intravenous salines are undoubtedly of great assistance in some cases. Pituitary extract and other drugs which raise the blood-pressure and stimulate renal activity are indicated; but, if they are administered, the patient should be carefully watched in case the rise of pressure should cause haemorrhage. The bowels should be freely opened, and hot packs and radiant heat may be employed to stimulate the skin.

Post-prostatectomy obstruction is a commoner complication when the

Post-operative obstruction

Freyer technique has been employed than it is after the open operation. In 85 per cent of cases collected by Thomson-Walker (1930) the narrowing was at the opening of the prostatic cavity into the bladder and was due to the surgeon's failure to remove the ledge of muscle and mucous membrane which separates the prostatic cavity from the bladder. The next commonest site of obstruction is where the urethra has been torn through at the time of enucleation; both of these types of case sometimes yield to dilatation by large metal bougies, but more often it is necessary to open up the bladder again and to remove the obstructing tissue. A possible alternative is some form of perurethral operation.

Prognosis of prostatectomy

Most patients with enlarged prostates are old men, and not uncommonly their health has been impaired by sepsis and deficient action of the kidneys. Prostatectomy is a major operation and, undertaken in these circumstances, must often entail a serious risk; and in assessing this risk various data must be taken into consideration. Age alone does not contra-indicate operation, for the death-rate does not increase *pari passu* with age. A hale old man of 80 may be a better subject for operation than a patient of 60 with a doubtful heart and impaired renal function. Arteriosclerosis increases the risk, but in Thomson-Walker's analysis of his results patients with a high blood-pressure did better than those in which the pressure was abnormally low for their age and were less likely to have venous thrombosis and pulmonary embolism.

Operation in the presence of other diseases

Disturbances of the alimentary tract causing constipation and distension are important, because ileus is a serious complication after prostatectomy. Since the discovery of insulin, glycosuria can no longer be regarded as a contra-indication to operation; it is now only a cause of delay until the urine has been rendered sugar-free by appropriate treatment.

It has already been pointed out that in a patient complaining of micturition troubles the existence of a nervous lesion due to tabes dorsalis must always be excluded. It may, however, happen that a tabetic patient may develop enlargement of the prostate; so that it may be doubtful whether his difficulty is due to prostatic obstruction or to atony of the bladder. In distinguishing residual urine due to a spinal lesion from that resulting from prostatic obstruction, the following points are helpful: (i) absence or diminution of desire for micturition indicating sensory disturbances, (ii) impairment of sensation in the prostatic urethra, (iii) the existence of spasmodic contractions of the compressor urethrae muscle, (iv) relaxation of the internal meatus during cystoscopic examination due to atony of the sphincter, and (v) the fineness of trabeculation and the existence of general sacculation of the bladder wall. If these signs and symptoms are present, operation will probably have little effect.

Of all the risks to which the patient convalescing from prostatectomy is exposed, those connected with the kidneys are the commonest and the most often fatal. It is for this reason that the careful examination of the renal function and pre-operative treatment are so important.

Mortality after prostatectomy

Statistics from various sources show that there is a considerable range in the mortality rate at different hospitals. Thomson-Walker (1930) reported that in 3,451 suprapubic prostatectomies performed at various general hospitals in this country there were 675 deaths, giving a mortality of 19·5 per cent. At St. Peter's Hospital, during 29 years, 2,691 suprapubic operations were performed with 286 deaths, i.e. a mortality of 9·9 per cent.

Perurethral methods of treatment

Various methods of removing obstructing portions of the prostate through the urethra have been devised during the last twenty years.

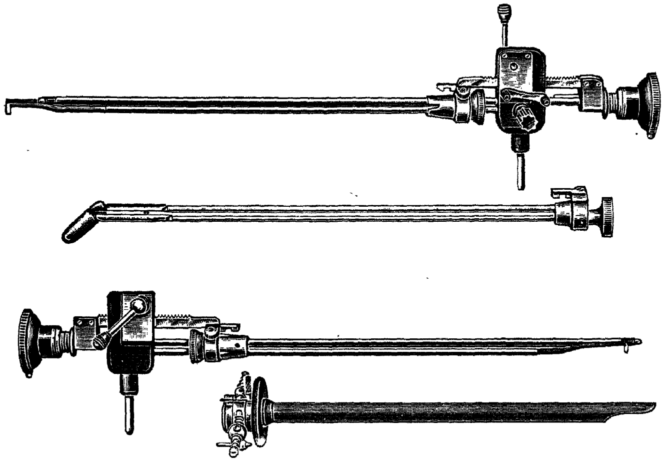

FIG. 15.—McCarthy electrotome

It is, however, only recently that these perurethral methods have taken an important place in prostatic surgery.

Perurethral resection has been made possible by two advances in urology: improvements in the construction of the cystoscope and the use of high-frequency currents in surgery. The older perurethral operations of Bottini, Civiale, and Mercier fell into disrepute because they were performed without visual control of the structures undergoing cauterization or section.

Technique with the McCarthy electrotom

With such an instrument as the McCarthy electrotome (see Fig. 15) it is possible to remove portions of the prostate under full visual control.

The bakelite sheath is first introduced with the obturator in position, and the latter is then withdrawn. After the bladder has been washed out, the loop electrode and the telescope are inserted, and the inlet tube of the irrigation system is connected with a large reservoir of sterile water. When the obstruction has been located, the loop is advanced beyond it by means of a rack and pinion, the cutting current turned on with the foot brake, and the loop withdrawn through the prostatic tissue. Cylinders of prostatic tissue are thus removed, the blood-vessels simultaneously being sealed by the coagulating action of the current. The telescope and loop are withdrawn at the conclusion of each movement of the loop, so that the adhering fragment of prostatic tissue may be removed. When the obstructing mass is large, as many as twenty to thirty cuts may be necessary before a satisfactory channel has been made. Considerable experience is necessary to gauge how much tissue must be removed in order to establish satisfactory micturition. If bleeding becomes excessive during the operation, a ball-electrode (see Fig. 16) is substituted for the cutting loop, and bleeding points are touched with a coagulating current. Before the instrument is finally removed, a whistle-ended rubber catheter with a large lateral eye is passed through the sheath into the bladder and tied in (see Fig. 17).

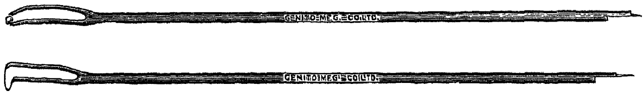

FIG. 16.—Ball and loop electrodes

Post-operative treatment

The catheter is left in position for a variable time up to a week depending on haemorrhage and sepsis. Every day the bladder is washed out frequently. If residual urine persists after the removal of the catheter and the subsidence of reactionary swelling of the prostate, it may be necessary to remove more tissue at a subsequent session.

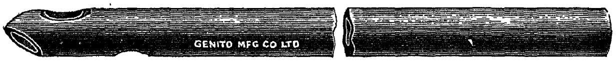

FIG. 17.—Rubber catheter with lateral and terminal eye for subsequent drainage

Treatment of complications of perurethral resection

The chief complications of this operation are haemorrhage and sepsis. The former is dealt with by careful coagulation of bleeding points at the time of operation and by frequent washing out with hot silver nitrate solution during convalescence. Sepsis is avoided by pre-operative lavage of the bladder, by frequent irrigation through the catheter during convalescence, and by giving calcium mandelate or sulphanilamide.

Pre- and post-operative care

Although perurethral resection is a much less serious operation than enucleation, the same pre-operative and post-operative care must be exercised as in the major procedure. Tests for renal function and, if the condition of the kidneys is unsatisfactory, a preliminary drainage should be carried out before operation. As with enucleation, the commonest cause of death after operation is septic infection of already damaged kidneys.

Indications for perurethral resection

It is important that this method of treatment should be restricted to suitable cases. Perurethral resection is not a substitute for prostatectomy; it is a method of treatment for certain selected cases and in special circumstances. The type of prostate most amenable to resection is one only slightly enlarged and yet causing considerable obstruction. Cases of enlargement of the middle lobe are better suited to perurethral methods than those in which the obstruction is mainly due to enlarged lateral lobes. Probably the most favourable case of all is the fibrous type of prostate in which obstruction is due to a thickened posterior lip to the internal meatus, or what is known in America as a fibrous prostatic bar. The special circumstances in which it may be used are when the major operation is contra-indicated either on account of the poor general health of the patient, the existence of some serious complication such as grave cardiac disease, or a high degree of impairment of renal function.

Fibrous prostatic bar

Some enthusiastic advocates of perurethral resection have stated that the method carries with it no risk or at any rate one that is negligible. This is an error, for not only must any operation on the type of patient on whom perurethral resection is often performed necessarily entail some degree of risk, but the operation itself can never be regarded as a minor one. In unskilful hands a McCarthy loop may do a great deal of damage, and cases of perforation of the rectum and of the bladder are by no means unknown. In the hands of an expert, however, prostatic resection has a death-rate of less than 5 per cent.

Prognosis of perurethral resection

4.–MALIGNANT DISEASE

(1)—Aetiology and Morbid Anatomy

There are two distinct clinical forms of malignant growth of the prostate; in one the prostate is cancerous from the outset; in the other the prostate has first presented the characters of a simple enlargement, the malignant change appearing subsequently engrafted upon it. The proportion of malignant prostates to simple enlargement is about 1 to 6 (Thomson-Walker, 1930).

Most of the malignant tumours of the prostate are spheroidal-celled scirrhous carcinoma, less often adeno-carcinoma; sarcoma is very rare, and recently doubt about the nature of tumours so reported has arisen. Bony metastases occur in prostatic carcinoma. Usually the growth starts in the posterior lobe and spreads towards the bladder. For a long time growth is confined to the prostate, but in the later stages metastases form, particularly in the bony skeleton, the vertebrae being most often attacked and then the femur, pelvis, ribs, and skull.

Morbid anatomy

(2)—Clinical Picture and Diagnosis

Difficult micturition is the commonest and often the first symptom. The stream is delayed and small, and the projection is feeble and followed by dribbling. There may be one or several attacks of retention, and eventually the patient depends partially or completely on the catheter. Pain occurs in 72·5 per cent of cases and is sometimes the initial symptom. The characteristic pain of prostatic carcinoma is unconnected with micturition or with obstruction to the flow of urine. It may be felt in the penis, rectum, anus, sacrum, groins, suprapubic

Sympto

region, or perineum. Usually it is a dull persistent aching unconnected with micturition and but little relieved by drugs. When the growth has spread outside the prostatic capsule it may infiltrate the sacral nerves and cause persistent sciatica.

Signs

On rectal examination the prostate is hard, irregular, and fixed. Stony-hard nodules may be felt in its substance separated by clefts and fissures. In advanced cases the prostate projects into the rectum as a large mass spreading over and surrounding the seminal vesicles and infiltrating the base of the bladder beyond the reach of the finger. Enlarged lymphatic glands are first felt as small shotty nodules in the bands which pass outwards on each side of the base of the prostate. The passage of an instrument is obstructed in the prostatic urethra, and the unyielding resistance of the gland may be felt. Emaciation is late and usually slight, and haematuria is absent in most cases.

Differential diagnosis

The conditions with which a malignant prostate may be confused are fibrotic induration of the prostate and prostatic calculi. To exclude calculi a pelvic radiograph should be taken. In the differential diagnosis between fibrosis and calculi a previous history of prostatitis and the presence of pyuria or of pus cells in the expressed prostatic secretion are helpful. In doubtful cases fragments of prostate may be removed through a resectoscope and examined microscopically.

(3)—Treatment

Palliative

Treatment may be palliative or operative. Most cases have progressed too far when the diagnosis is made for any radical operation to be considered. Treatment in such cases consists of the relief of obstruction by catheterization, by a perurethral operation, or by the establishment of a permanent suprapubic drain. Formerly most cases were treated by permanent drainage, but, if the McCarthy instrument can be introduced through the tortuous and resistant posterior urethra, perurethral resection will often avoid the necessity of a permanent drainage.

Relief of pain

For the pain phenacetin 10 grains, antipyrin 10 grains, caffeine 3 grains, or aspirin 10 grains should be given in a cachet. When the pain is very severe, other methods of obtaining relief may be necessary, e.g. resection of the pre-sacral nerves or injections of alcohol into the theca. By placing the patient in the correct position at the time of injection, the alcohol can be brought into contact with the nerve-roots carrying the pain fibres.

Radium and X-ray therapy

Two other palliative measures may be employed: radium and deep X-ray therapy. On the whole the results of radium therapy have proved disappointing, whether needles have been inserted through the perineum into the prostate, radon seeds have been implanted, or a radium bomb has been used. Recent improvement in the technique of deep X-ray therapy and the substitution of high for comparatively low voltage machines have produced better results. In many cases symptoms are relieved for nine months or a year, and the prostate is reduced in size and hardness, but in most cases the improvement is temporary only. It is, however, undoubtedly the best means of dealing with inoperable cases at present available.

Operative

In only a few instances is removal of the prostate possible. Radical operations were formerly practised, but most British surgeons have given these up on account of the rapidity of recurrence. H. H. Young still records favourable results from the perineal operation, but his successes have not revived general interest in radical operations. When a prostate has been enucleated, and subsequent microscopic section proves that it is not wholly innocent, but contains an area in which malignant changes are apparent, deep X-ray therapy as a prophylactic measure against recurrence must be considered. I am under the impression that this may considerably prolong the period of freedom from recurrence.

5.-CALCULI

Types of prostatic calculi

Prostatic calculi occur in middle life or old age. Three types have been described: originating in (*a*) the substance of the gland, (*b*) the prostatic urethra, and (*c*) pouches communicating with the prostatic urethra. The first and last named may be considered primary in that they are formed where they are found, whereas calculi in the prostatic urethra are secondary, being derived from the bladder or from the kidneys and having the composition of vesical or renal calculi. Calculi forming in the gland are usually small, varying in size from a grain of sand to a millet seed. They generally occur in old age. Both the organic and the inorganic constituents of these calculi are derived from the prostatic secretion. The inorganic salts most commonly found are calcium and magnesium phosphate. Sodium and potassium phosphate and calcium oxalate may also be present.

Symptoms

The symptoms are often obscure. Pain is most commonly felt either as discomfort during micturition or as a constant aching referred to the rectum, testes, perineum, groin, or thigh. Haematuria is common, as is also a purulent urethral discharge. Frequency and difficulty are common.

On rectal examination a small accumulation of calculi in the prostate may resemble the induration felt in chronic prostatitis. Sometimes, however, crepitation may be obtained from one calculus grating against another. The passage of a sound gives little information, unless the calculus communicates with the prostatic urethra, when the instrument grates against its surface. The differential diagnosis from chronic prostatitis is settled by a radiograph of the pelvis.

Diagnosis from chronic prostatitis

Treatment

Treatment is necessary only if the multiple calculi cause serious symptoms, such as continuous pain or sepsis. A collection of small calculi in one lobe of the prostate should be removed by the perineal route. When the prostate is enlarged or causes obstruction, or when the calculi are scattered throughout the whole gland, suprapubic prostatectomy should be performed. Since prostates of this type cannot be enucleated by the fingers, a good exposure of the bladder base and careful dissection and removal of the prostate are necessary.

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PROTEINURIA

See ALBUMINURIA, Vol. I, p. 273

PRURIGO, BESNIER'S

See ALLERGY, Vol. I, p. 327

PRURITUS AND PRURIGO (HEBRA)

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Reference may also be made to the following titles:

ALLERGY
ANUS DISEASES
DIABETES MELLITUS
ERUPTIONS, ANOMALOUS AND ATYPICAL
HODGKIN'S DISEASE
OXALURIA

I.—PRURITUS

1.—DEFINITION

1309.] The term pruritus is applied to itching when it is apparently the primary affection and not symptomatic of recognized disease of the skin. The terms primary and secondary pruritus are used by some. In this case secondary pruritus refers to the itching which is a symptom common to many skin diseases.

2.—AETIOLOGY

Primary and secondary types

Pruritus may be primary or may accompany a demonstrable skin disease. (For the secondary types see the articles on the respective primary diseases.)

Concomitants

Primary pruritus may be associated with scratch marks, linear pigmentation, decapitated follicles, and pyogenic infection, e.g. pustules and boils; but these are the results of scratching.

Uncomplicated pruritus

In uncomplicated pruritus the only symptom is itching; the patient therefore comes for advice with a ready-made diagnosis, and the practitioner has only to discover the cause of, and means of relieving, the itching. Little is known about the mechanism of itching, and even the most careful examination may fail to discover and remove the cause.

General and regional pruritus

Pruritus may be general or regional. Many of the causes of general pruritus also produce regional pruritus; therefore the investigations desirable in general pruritus will be described first, and subsequently the additional investigations required in local pruritus.

3.—CLINICAL INVESTIGATION

(1)—General Pruritus

The patient should be stripped to the waist, because this allows an examination of the underclothes and exposes a large area of skin.

Underclothes

The material of the underclothes should be noted. Harsh woollen underclothing may cause itching, but to this the patient will generally be alive. On very rare occasions undyed artificial silk has been proved to cause itching, and this is usually unsuspected by the patient.

Reaction of skin to exposure

The reaction of the skin to exposure should next be observed. Contraction of the arrectores pilorum muscles is a normal effect of the change of temperature, but in some people this is strikingly exaggerated.

Surface parasites

A rigorous search for surface parasites should then be carried out, even in clean people. In a case of general pruritus without obvious eruption I found eventually on one finger a single vesicle from which a live acarus was extracted; further search revealed no abnormality on any part of the skin, and the itching ceased at once when treatment for scabies was instituted. Mild but wide-spread infestation with *Pediculus pubis* may occur in hairy men without any obvious signs of eruption. A comparatively light infestation of the hair in women with pediculosis capitis may cause irritation not only of the scalp but also of the shoulders and trunk almost down to the waist. Well-to-do elderly people may carry the *Pediculus corporis* but show very little evidence of scratching.

Texture of skin

The texture of the skin should next be examined. Undue dryness of the skin is liable to be associated with itching. The inborn peculiarity known as xerodermia may be irritable but is not often so in youth. On the other hand, the dryness of old age, especially when associated with atrophic changes, such as fine wrinkling, loss of elasticity, and almost imperceptible scaling, is so often associated with itching that the term pruritus senilis is commonly used, and at a less advanced age the frequency of itching in winter associated with dry skin has given rise to the term pruritus hiemalis. (The condition of prurigo aestivalis or hydroa vacciniforme is referred to in the article HAEMATOPORPHYRINURIA, Vol. VI, p. 93.)

Pruritus senilis

Pruritus hiemalis

Urine

Albuminuria

Glycosuria

Bact. coli

Oxaluria

Phosphaturia

Bile-acids and urobilinogen

A careful examination of the urine should next be carried out. Albuminuria is not commonly associated with pruritus unless it is accompanied by excessive dryness of the skin. Glycosuria is frequently accompanied by itching, which may be general, but more often it produces a local pruritus due to the irritating quality of the urine. Urinary infection with *Bact. coli* may also cause general itching, but it is generally associated with chronic urticaria. It is also one of the causes of vulval pruritus. Excessive oxaluria is another frequent cause of itching and is often accompanied by general nervous irritability. High phosphaturia also may be associated with irritation, generally of the genital organs, and in my experience occurs in males only. Examination should also be made for the presence of bile-acids and urobilinogen, because, if found, they are of the utmost importance. Any tendency to slight icterus should be noted.

Blood

In some obstinate cases it is well to have the blood-sugar estimated, because a high blood-sugar may cause itching without glycosuria.

Baths

Inquiry about the number of baths, whether or not bath salts are used, and how much soap is used should also be made. Genner, convinced of the importance of these as factors, used the term 'bath pruritus'.

Diet

Dietetic habits must also be investigated (see under Treatment on p. 169).

Focal infection

Though not a common cause, focal infection, especially root infection of the teeth, should also be borne in mind.

Nervous system

The condition of the nervous system should be examined. Pruritus is occasionally found in tabes dorsalis and in early paralysis agitans, in the latter even before nervous disease has been suspected. Apart from gross organic disease pruritus is not infrequent as a sequel of severe nervous shock or prolonged worry and consequent nervous exhaustion. Lastly, the possibility of early Hodgkin's disease should be borne in mind, since generalized pruritus sometimes occurs before glandular enlargement is obvious.

(2)—Regional Pruritus

All the factors mentioned above may produce regional pruritus, but others are special to the local area.

(*a*) *Pruritus Ani*

Appearance of anal region

The anal region is seldom normal in appearance in pruritus ani of any standing. The mucous membrane is generally sodden and macerated, and this condition extends frequently for a variable distance up the intergluteal fold. It is in most cases due either to a slight anal discharge or to constant rubbing and scratching. Leakage of ingested paraffin is sometimes responsible. An itching anus is almost always moist.

Oxyuriasis

Every patient with severe or obstinate pruritus ani should be examined carefully for oxyuriasis, which occurs far more frequently in adults than is generally imagined.

Piles
Fistula

The rectum should be examined for internal piles and, perhaps more important, for fistula. The anal orifice should also be examined for rugosities and external piles.

Epidermophyton inguinale

Castellani incriminated infection with *Epidermophyton inguinale* as a frequent cause. In my experience it is rare.

Staphylococci and Bact. coli

Montague, after an exhaustive research on the subject, believed that infection of the skin with staphylococci and *Bact. coli* was responsible for many cases; but it appears to me to be impossible to determine whether this infection is primary or secondary, due to scratching. If secondary it may be a factor in keeping up the pruritus. (See also ANUS DISEASES, Vol. I, p. 677.)

(*b*) *Pruritus Vulvae*

Urine

Examination of the urine for sugar and for bacillary infection is important.

Vaginal discharge

The presence or absence of vaginal discharge should be noted. Any discharge should be examined for the type of bacteria present and above all for the presence of *Trichomonas vaginalis.* Not very commonly *Oxyuris* may wander into the vagina.

Leukoplakia

Leukoplakia of the vulva when well established is obvious, but in the earliest stages it may fail to be observed and should therefore always be borne in mind. Elizabeth Hunt analysed a large number of cases of pruritus vulvae and contended that a high proportion were due to localized lichen planus, but this is not the experience of most dermatologists.

(*c*) *Pruritus Axillaris*

This is a far less common affection than pruritus ani or pruritus vulvae, and I have seen it only in women. The axillae should be examined with a lens as well as with the naked eye.

Causation

The use of preparations to check sweating, usually strong solutions of aluminium chloride, may cause itching first and subsequently dermatitis. Loose dye in dresses may penetrate into the axilla even through undyed linings and cause itching. Occasionally the use of depilatory powders, usually alkaline polysulphides, is a cause. Shaving if carried out should be repeated frequently. Shaving *per se* is not injurious, but short stubbly hair is very likely to cause itching. Lastly, a careful search should be made with the lens for an early stage of the rare Fox-Fordyce disease, which may easily escape notice.

4.–TREATMENT

(1)—General

Certain articles of diet seem to cause itching in patients without any evidence of indigestion or other constitutional abnormality; these are excess of salt somewhat rarely, pepper and all spices much more commonly, and coffee in excess. In the presence of oxaluria, foods containing oxalates should be avoided as far as possible, a matter of great difficulty, and the carbohydrates should be kept as low as is compatible with general health. Sometimes raw fruit, especially when taken late at night, excites nocturnal pruritus. *Diet*

Alcohol, if taken at all, should be in very moderate amounts, and especially should be freely diluted. *Alcohol*

Tobacco should be consumed only very moderately and cigars forbidden entirely, because they are much more commonly associated with pruritus than are either pipes or cigarettes. *Tobacco*

Internal treatment is founded on such errors of metabolism as may be discovered. Small doses of dried thyroid may be useful in senile pruritus; this, though not often effective, sometimes has an almost miraculous influence. Unfortunately, I know of no method (other than trial) of selecting those patients who will benefit. *Thyroid*

Two other methods of internal treatment may be used in cases in which no constitutional defect is discoverable: autohaemotherapy and lumbar puncture. In autohaemotherapy it is better to begin with a small dose, 2 c.c. of blood being taken from an arm vein and injected before clotting into the buttock. This is repeated with 4 to 5 c.c. in five days' time, and then a series of weekly injections of 5 to 10 c.c. is given. *Autohaemotherapy*

Lumbar puncture is of especial use in cases of nervous origin. That it is not, as has been claimed, a treatment by suggestion is proved by the fact that, if too little of the fluid is withdrawn, relief does not follow. Not less than 8 c.c. should be drawn off, and the patient should be kept in bed for twenty-four hours after this procedure. *Lumbar puncture*

Clothing should be of a cotton and linen mixture, because even silk is irritating to some people and wool, however soft and smooth, to many. Beneath woollen stockings undyed Lisle thread may be worn; this obviates in some degree the slight chapping which occurs with wool in cold weather. *Clothing*

Baths should be taken only every other day and are best made slightly *Baths* hypertonic with common salt. One pound of salt in ten gallons of water makes a 1 per cent solution and will be generally suitable. To this may be added small quantities of a coal-tar product, such as 2 fluid drachms of cyllin or izal, but not lysol, and no soap should be used. The temperature should be carefully adjusted, from 90° to 95° F. being usually best. Drying should be carried out with a soft linen towel with as little friction as possible.

Bed-clothes

Bed-clothes should be as light as can be used without actually chilling the patient.

(2)—Local

Not uncommonly no indication can be found for internal treatment even after the most careful investigation, and in this event reliance must be placed on local treatment. This, however, is less discouraging than might be expected. A habit of itching seems to develop in some cases, and if the itching can be subdued and prevented for some weeks it often fails to return.

Radiotherapy

Adequate doses of X-rays are almost invariably of at least temporary benefit, but their very efficacy constitutes a danger. The treatment is so cleanly and leaves so little for the patient to do that he is likely to put pressure on the practitioner to repeat it for longer than is safe, and consequently patients with radio-dermatitis and atrophy are still seen. If used at all, X-rays should be limited to a total of two erythema doses subdivided into quarter doses administered once in ten days with an interval of at least three weeks after the first four doses. Unfiltered rays used in this way give the best results.

Medicaments

Tarry preparations

For use in wide-spread pruritus the medicaments applied should be as cleanly as possible and should contain either little or no grease. Tarry preparations are usually best; these may be of either wood-tar or coal-tar. As a solvent 40 to 60 per cent alcohol with 2 per cent glycerin is usually well tolerated, e.g.:

Solution of coal-tar – – –	2 fl. drachms
Glycerin – – – – –	1½ fl. drachms
Industrial spirit – – –	– to 8 fl. ounces

For the coal-tar solution may be substituted oil of cade 1 fluid drachm or birch-tar oil 1 fluid drachm.

In cases in which the skin is rather harsh and dry a small quantity of grease may be indicated, but this should be kept so low that the skin does not feel sticky when the lotion has dried.

The following emulsion serves well as a base to which various antipruritics may be added:

Liquid paraffin or sesame oil – – –	1 fl. ounce
Talc – – – – – –	1 ounce
Tragacanth – – – – –	25 grains
Industrial spirit – – – –	1 fl. ounce
Distilled water – – –	– to 8 fl. ounces

The proportion of coal-tar or wood-tar given above may be added to it, or an addition of chloral hydrate and camphor of each 60 grains may be made.

Acetic acid

In some cases weak acetic acid seems to act beneficially, especially when used with mercuric chloride:

Glacial acetic acid – – – –	1 fl. drachm
Mercuric chloride – – – –	2 grains
Industrial spirit – – – –	2 fl. ounces
Glycerin – – – – –	1½ fl. drachms
Camphor water – – – –	to 8 fl. ounces

Menthol cone

Lastly, in some generalized cases, especially when the itching is spasmodic, the patient may be given a menthol cone to rub over the skin. This does not produce any sign of irritation, but the patient should be warned about the peculiar sensation it produces; some patients cannot tolerate the chilly sensation following its use.

In anal and vulval pruritus there is an added complication in that, these being rather 'septic' areas, the skin is almost always infected by the rubbing and scratching.

Silver nitrate

Mercuric chloride

The best initial application is usually silver nitrate, at first of a low strength, varying according to the degree of excoriation present. The lowest concentration that I use is 1 in 2,000 in 5 per cent alcohol. This may be raised rapidly until 1 to 2 per cent is reached, beyond which it is seldom necessary to go. The strength of the alcohol may also be raised from 5 to 25 per cent; in some instances it may with advantage be made up in solution with peppermint water instead of distilled water. The patient must be warned of its staining properties, but, if care is used, there is no necessity to discolour the clothes, because it does not come off when dry. Another lotion sometimes of service in anal and vulval cases, recommended by Lenthal Cheatle (personal communication), is a watery solution of mercuric chloride, used at first in a strength of 1 in 2,000 and raised to 1 in 500 if necessary. It should not be used inside the vagina.

Ointments

Many observers object to the use of ointments, on account of their heating and macerating properties. These are greatly lessened if a base is used which is free from stickiness, e.g.:

Menthol – – – – –	15 grains
Mercurous chloride – – – –	20 grains
Soft paraffin – – – – –	120 grains
Coconut oil – – – – –	480 grains

In hot weather it is well to incorporate hard paraffin 10 grains in the ointment, which might otherwise melt and allow the mercurous chloride to deposit.

For pruritus ani coal-tar may be used according to the formula of Charles White of Boston:

Prepared coal-tar – – – –	30 minims
Zinc oxide – – – – –	30 grains

These two ingredients to be mixed intimately and then incorporated with the following, which have been previously mixed:

Starch	180 grains
Soft paraffin	300 grains

This formula is very slightly altered from White's, which is rather stiff. It should be used only in the absence of visible suppuration; otherwise the skin should be cleaned up first with the silver nitrate solution. The patient should squat on his heels so as to open the anal fold, and the ointment should be rubbed in very gently from the centre to the periphery so as to enter all folds. If it is applied at night, it can be removed with olive oil next morning, and much messiness thus obviated.

Subcutaneous injection The A.B.A. method of treatment consists in the subcutaneous injection, round the posterior part of the anus, of 2·5 c.c. of a solution called A.B.A., i.e. benzocaine 3, benzyl alcohol 5, ether 10, and sterile olive oil to 100. The procedure is repeated in a week's time, when slightly larger doses are given, and again one week later. Relief is almost instantaneous but not permanent.

Division of cutaneous nerves Surgical operation, i.e. subcutaneous division of the cutaneous nerves under a general anaesthetic, also gives practically instantaneous relief, which lasts about six weeks; but, unless the underlying cause of the pruritus has been removed, the itching returns.

II.—PRURIGO (HEBRA)

1.—DEFINITION

1310.] This is a rare disease beginning in childhood, persisting throughout life, and characterized by continuous itching associated with pale shot-like papules and chronic enlargement of the subcutaneous lymphatic glands.

2.—AETIOLOGY

Distribution This disease was always rare in England; formerly frequent in eastern Europe, it has now become less common. *Relation to lichen urticatus* There was some dispute at one time whether or not cases of lichen urticatus, a common disease of infants in England, developed into prurigo after five or six years of age, as was claimed by Kaposi, but this question is now settled in the negative. Colcott Fox followed up many of his cases of lichen urticatus, but none exhibited prurigo as they grew older.

Age incidence The disease begins usually at about five years of age with intolerable and practically continuous itching, which affects chiefly the extensor surfaces of the limbs but may occur anywhere.

It is still doubtful whether or not the characteristic eruption is only a secondary result of the continual scratching and rubbing.

Relation malnutrit

Aetiologically it is almost certainly bound up with defective nutrition, and deficiency of various vitamins has been incriminated. Dust of dirty rooms, especially that containing moulds, and bites of parasitic insects have also been suspected, but the nutritional hypothesis is now most generally held.

3.–CLINICAL PICTURE

Lesion

Skin

Glands

The supposedly characteristic lesion is a pale indurated papule the size of a mustard seed. This is nearly always seen in a stage of decapitation resulting from the scratching, and from the same cause the whole skin becomes harsh and dry and often affected with pyogenic dermatitis. The lymphatic glands of the groin, axillae, and neck enlarge, sometimes to a great size, though they are usually painless.

If one limb is kept covered up firmly so as to preclude scratching, the papules cease to develop, although the itching continues; it is therefore probable that all the signs present are due to the continued scratching.

4.–COURSE AND PROGNOSIS

In the severe cases seen in central and eastern Europe life is sometimes shortened.

5.–DIAGNOSIS AND DIFFERENTIAL DIAGNOSIS

Diagnosis from lymphadenoma pseudo-leukaemi prurigo

The diagnosis is obvious the moment the patient is stripped, and the only disease which could be confused with it is lymphadenoma with so-called pseudoleukaemic prurigo, because the enlarged lymphatic glands and the pale papules are present in both; but careful investigation would always enable them to be distinguished.

6.–TREATMENT

Treatment of the severe case is unsatisfactory, but special attention should be given to the diet and surroundings, cod-liver oil being of some benefit. Locally, soaking in mildly alkaline baths, followed by inunction with a bland ointment containing an antipruritic, is best. The following ointment may be used:

Cyllin – – – – –	15 minims
Starch – – – – –	3 drachms
Olive oil – – – – –	1½ fl. drachms
Hydrous wool fat – – – –	to 1 ounce

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PSEUDO-COXALGIA

See EPIPHYSES, DISEASES AND INJURIES, Vol. V, p. 131

PSITTACOSIS

SECTIONS 1–4, AND 7 (PART)
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Reference may also be made to the following titles:

PNEUMONIA, LOBAR
PYREXIA OF OBSCURE ORIGIN

1.–DEFINITION

1311.] Psittacosis is an infective disease caused by a filterable virus transmitted to man by certain birds, especially parrots and parakeets.

2.–AETIOLOGY

Before the pandemic of 1930 it was generally accepted that Nocard's *Bact. psittacosis,* which is identical with *Bact. typhi-murium* (*Bact.*

aertrycke), was the cause of psittacosis. The evidence in support of this was meagre in the extreme, and investigations carried out in 1930

Causal agent

both in England and elsewhere showed conclusively that the causal agent was a filterable virus (Bedson, Western, and Simpson; Levinthal; Krumwiede, McGrath, and Oldenbusch).

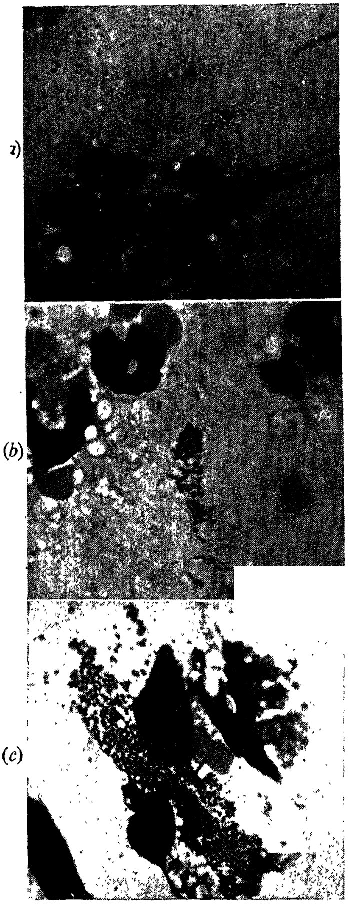

FIG. 18.—Smears of spleen of mouse infected with psittacosis, showing (*a*) virus in the form of elementary bodies scattered irregularly throughout field; (*b*) clump of virus consisting of large forms; (*c*) large clump of virus composed of particles ranging in size from large forms down to elementary bodies, the majority, however, being intermediate between the two. Giemsa stain; × 900

Staining of virus

The virus of psittacosis is one of the largest of the group of filterable agents and is readily visible under the microscope. Although more difficult to stain than the cultivatable bacteria, this virus can be demonstrated with ease by prolonged staining with dilute Giemsa, as used for staining the spirochaete of syphilis, or more rapidly by the use of one of the modifications of Castañeda's rickettsial stain (formol methylene blue in phosphate buffer solution).

Variation in size of virus

The virus varies considerably in size. The smallest forms, the so-called 'elementary bodies', are about 0·25μ in diameter and look like very minute cocci (see Fig. 18, *a*). They stain purple with Giemsa and bright blue with Castañeda and, when extracellular, occur singly and in pairs, short chains, and irregular groups of various sizes. Inside cells they form more or less compact groups or colonies in the cytoplasm. The largest forms (see Fig. 18, *b*) are 0·8 to 1·0μ in size, are roughly circular or oval, and stain blue with Giemsa and reddish-purple with Castañeda. They sometimes show polar staining, and forms undergoing division are seen. Between these two extremes virus particles of various sizes occur (see Fig. 18, *c*). Like the elementary bodies the large and intermediate forms occur as compact colonies in the cytoplasm of the infected cells

—endothelial phagocytes, Kupffer cells, and bronchial and alveòlar epithelium—and when seen free outside cells in smear preparations show no particular arrangement. The meaning of this pleomorphism shown by the virus is as yet unsettled. Possibly the different forms represent stages in the development of the virus (Bedson and Bland), the large forms being the youngest and the elementary bodies the mature form of the virus; or, as Levinthal thinks, the large forms may be the result of the action of the newly infected cell on the virus. In smear preparations and sections of morbid material the form most commonly seen is the elementary body.

Significance of pleomorphism

Like other viruses psittacosis virus is unable to multiply apart from living cells; it is an obligatory intracellular parasite, and can be cultivated *in vitro* with chick-embryo tissue either in plasma-clot cultures or by the Maitland method (minced chick-embryo and Tyrode solution in a shallow layer); the chorio-allantoic membrane of the developing egg also provides an admirable medium for the growth of this virus.

Cultivation

Birds of the parrot family are the natural host of this virus, but many other species of birds, e.g. various finches, canary, and Java sparrow, contract the disease more or less readily when brought in contact with infected parrots or parakeets. Infection of the bird may not be apparent, particularly in the budgerigar, *Melopsittacus undulatus.* Apparently healthy birds may thus carry the virus and are a potent source of infection. Mice, guinea-pigs, rabbits, and monkeys can be infected experimentally; of these the mouse is the most susceptible and constitutes the animal of choice for experimental work. Man appears to be highly susceptible, infection taking place through inhalation of infective droplets or dust (dried droppings); the conjunctiva in all probability is another portal of entry of the virus. Though infection from man to man undoubtedly takes place, the relatively low degree of infectivity of the human case compared with that of the diseased bird is striking. This is probably due to the distribution of the main lesions in birds and man and the consequent effect of this on the route of excretion of the virus; in the bird the principal foci of infection are in the spleen and liver, and the virus is present in abundance in the droppings, whereas in man the principal lesions are pulmonary, and the sputum, though infective, is notoriously scanty.

Susceptible species

Carrier state in birds

Susceptibility of man

Relative infectivity of man and bird

3.–IMMUNITY

Experimentally infected animals that recover are resistant to reinfection, but the mechanism of this immunity is by no means apparent. Resistance to many virus infections would seem to be largely a function of neutralizing antibody, but, in psittacosis, although infection results in the production of specific antibody, the neutralizing power of the serum is never great. It is thought that in man recovery from infection results in immunity, and the scarcity of records of two attacks of psittacosis in

Mechanism

Immunity conferred by an attack

the same individual supports this view. In the serum of human convalescents specific antibodies can also be demonstrated by the neutralization test and by the complement-fixation reaction; but, as in the experimental animal, low titres only are found.

Artificial immunization

A considerable degree of immunity can be produced experimentally in the mouse by the injection of virus which has been inactivated by formalin in low concentration (0·1 to 0·2 per cent formalin). Rivers and Schwentker have shown that fully active virus can be inoculated subcutaneously in monkeys without producing infection, and that the animals so treated become immune. They have applied the same procedure to man without untoward result; neutralizing antibody in low titre appeared in the serum of the immunized individuals.

4.–MORBID ANATOMY

In general terms the post-mortem findings in psittacosis are those of a septicaemia with inflammatory changes in the lungs of a somewhat unusual nature.

Upper respiratory tract

Lungs

Macroscopical appearance

The mucosa of the pharynx, larynx, and trachea is usually red and injected; very occasionally more or less extensive patches of a greyish adherent membrane may cover the inflamed areas. The lungs almost invariably present some degree of consolidation varying from scattered nodules to confluent areas occupying an entire lobe. Although in some cases the gross appearances may thus suggest lobar pneumonia, all authorities agree that the inflammatory process is essentially lobular in origin and not secondary to a bronchitis as in broncho-pneumonia, although the bronchioles may be invaded (Turnbull; Lillie). The cut surface of the consolidated areas is most commonly grey or greyish-red, moist, and smooth or finely granular; more rarely it is red or bluish-red. Red hepatization of lobar or confluent lobular distribution is more commonly seen in those succumbing before the thirteenth day of disease, whereas grey or greyish-red nodular or lobular consolidation occurs more frequently in those dying later (Lillie); but the areas of consolidation in the same lung are not infrequently at different stages of development. Unconsolidated lobes commonly show congestion and oedema.

Histology

A feature of the histology of psittacosis pneumonia is the variation in the picture seen in the alveoli even in the same microscope field. Some may contain serum only, others serum and red blood-corpuscles, and still others in addition desquamated alveolar epithelial cells, mononuclear phagocytes, and polymorphonuclear leucocytes, though the last type of cell is rarely numerous; fibrin may or may not be present. The alveolar epithelial cells are usually swollen and show fatty degeneration, and virus may be demonstrable in these cells as well as in the mononuclear phagocytes. The alveolar septa may be thin or inconspicuous or swollen and oedematous, and they may be infiltrated with lymphocytes, mononuclear phagocytes, mast cells, and polymorphonuclear leucocytes. Focal necrosis of the alveolar walls is sometimes seen, and thrombosis of capillaries and branches of the pulmonary artery, a late and infrequent event, may be extensive (Turnbull).

Pleura Small haemorrhages beneath the pleura are common. Pleurisy occurs in about 30 per cent of cases. In some this is confined to a dullness and opacity of the pleura overlying the pneumonic areas, whereas in others a thin easily detachable fibrinous exudate covers the affected areas, sometimes extending over the greater part of the pleura. Pleural exudate, except in small amount, is rare; it may be serous, haemorrhagic, sero-fibrinous, or even purulent. *Pericardium* Changes in the pericardium consist of petechial haemorrhages and rarely a serous or sero-fibrinous exudate. Of the fifty-two cases analysed by Lillie twenty-eight showed no change in the serous membranes.

Spleen A moderately enlarged spleen, soft or diffluent in texture and red or deep red in colour, is the usual finding. The principal histological changes are congestion and infiltration of the pulp with large lymphoid cells and polymorphonuclear leucocytes. The large mononuclear phagocytes, both fixed and free, are increased in number, and active phagocytosis of red corpuscles is sometimes prominent. Rarely the virus may be demonstrable microscopically in the mononuclear phagocytes.

Liver As a rule swelling, congestion, and parenchymatous degeneration are the only naked-eye changes in the liver. On histological examination, however, small foci of necrosis are sometimes observed, in which the hepatic cells are very acidophilic, often shrunken and dissociated, and the area is infiltrated with polymorphonuclear leucocytes. Swelling, vacuolation, and increased phagocytic activity of the Kupffer cells are common (Lillie), and occasionally the virus can be seen in these cells.

Kidneys Swelling and parenchymatous degeneration constitute the gross changes seen in the kidneys. Microscopical examination usually shows swelling and granular degeneration of the cells of the convoluted tubules. More rarely the process may proceed as far as necrosis, and hyaline or granular casts are seen within the tubules.

Adrenals Although central softening has occasionally been noted, the naked-eye appearance of the adrenals is usually normal. Microscopically focal areas of swelling and vacuolation or even necrosis of the cortical cells may be observed.

Gastro-intestinal tract Generally speaking, the changes in the gastro-intestinal tract are slight; in fact Sturdee and Scott drew attention to the mildness of these lesions in contrast with the changes present in enteric fever. *Oesophagus* Oedema and focal congestion of the oesophagus may be observed, and on histological examination the submucosa in these areas is seen to be infiltrated with plasma cells and large mononuclears. The mucosa of the stomach may show haemorrhages, haemorrhagic erosions, or even small ulcers. Less commonly patchy congestion of the mucosa of the small and large intestines and small mucosal haemorrhages are present.

Right-sided dilatation of the heart is common, and pallor and cloudy

Cardio-vascular system swelling of the myocardium have been observed, histological examination showing fragmentation and granular degeneration of the muscle-fibres. Foci of infiltration with polymorphonuclear leucocytes and plasma cells may occur. Venous thrombi have been observed in a few cases (Lillie).

Muscles Degenerative changes and haemorrhage in the muscles, more particularly in the rectus abdominis, are common. The affected muscle is very pale and waxy in appearance, and histologically the muscle-fibres are swollen and have lost their transverse striation; their nuclei have usually disappeared as the result of chromatolysis.

Central nervous system The changes in the central nervous system are those common to many infective processes and take the form of congestion and oedema of the meninges and of the brain and cord. Ring haemorrhages may occur (Turnbull), and multiple foci of softening have been described (Hegler).

5.–CLINICAL PICTURE

Incidence The clinical features of the French epidemic in 1892 were almost identical with those of the pandemic which occurred in North and South America, England, France, and Germany in 1930. Psittacosis in man is a severe illness with a high mortality. It affects all ages and both sexes.

Incubation period The incubation period is usually about ten days. It may vary from eight to fourteen days, and, in exceptional instances, is as short as four days or as long as fifteen days or more.

Onset The onset is usually fairly acute, the patient taking to bed within a few hours of feeling ill. The first symptoms are usually vague, consisting of malaise and feverishness. There may be headache, epistaxis, vomiting, sweating, backache, pains in the limbs, or rigors. About 15 per cent of cases have an ambulatory period of malaise varying from 3 to 12 days before taking to bed. The presence or length of the ambulatory period is no indication of the severity of the subsequent symptoms.

Pyrexia Pyrexia occurs in all cases and is in many respects similar to that of enteric fever, except that it is sometimes of abrupt onset. The patient, when seen for the first time, often has a temperature of 101° or 103° F. Continuous fever, with only slight morning remissions, persists and falls by lysis towards the end of the second week. Occasionally the temperature is remittent, with a difference of several degrees between the morning and evening readings. Termination by crisis occurs, though rarely. Rigors are not uncommon, both as the initial symptom and towards the end of the first week coincident with the involvement of the lungs. Even severe and repeated rigors are compatible with recovery.

Epistaxis Epistaxis occurs in about 25 per cent of cases, usually on the first day or within the first few days; it is usually brisk and sometimes calls for nasal plugging.

Headache Headache is constant, occurring at the onset, attaining its maximal intensity in about ten days and then gradually diminishing. The type of headache varies: throbbing, pressing, or aching; it is nearly always very intense and may be frontal, occipital, or nuchal. It is occasionally associated with head retraction, is often severely aggravated by paroxysms of coughing, and is associated with, if not the cause of, sleepless nights. Pain or generalized aching is an early feature, and not infrequently the pain is localized to the lumbar region.

Pain

Sore throat in mild degree is frequent; less commonly the fauces and soft palate are red and covered with a yellowish exudate. Sordes on the lips are not unusual; in some instances of mouth to beak feeding the patient is bitten by the parrot and the lips and mouth may swell severely. Cough is common; it varies in intensity, usually appearing after the first few days. Sometimes the paroxysms are exhausting and aggravate the severe headache and insomnia. Sputum is scanty in most cases and absent in some, even though extensive physical signs are present in the chest. The sputum is mucoid, muco-purulent, or frankly purulent. In a few instances it is stained or even freely mixed with bright blood. Occasionally the rusty sputum characteristic of pneumonia appears.

Throat and tongue

Cough

Sputum

Signs in the lungs begin, in a typical case, on the fifth day of the illness, when a few crepitations are heard at the base of one or both lungs. At the same time some rhonchi may be heard at the apices or scattered throughout the lungs. The percussion note at the base of the lung is slightly impaired, and after a few days a small area of consolidation appears, usually near the angle of one scapula. During the second week similar signs are found in patchy areas in other parts of one or both lungs, usually at the base. The distribution of these foci may vary from day to day and give the impression of a wandering pneumonia. Sometimes several foci appear to fuse, so that a large portion or even the whole of one lung and perhaps part of the other lung may be involved. Occasionally no breath-sounds can be heard in these areas, the signs being those of pleural effusion without displacement of the apex beat. The signs usually begin to diminish towards the end of the second or the beginning of the third week, and resolution is indicated by the return of the percussion note to normal and by the appearance of numerous moist sounds, which often persist well into convalescence; but resolution is ultimately complete. In a few cases a transitory pleural friction rub is heard, and small pleural effusions have been noted. Empyema has not been observed.

Signs in the lungs

Even when the respiratory rate rises considerably, there is not any real respiratory distress. The patient lies flat in bed, perhaps complaining of headache or cough, but never of difficulty in breathing. Although the alae nasi are working, the features of distress seen in pneumonia are absent. Cyanosis is not common; it does, however, occur in about one-third of the cases, and it may be considerable in fatal cases. It does not approximate to the intensity of the cyanosis seen in the influenza epidemic of 1918. In nearly all cases at some stage in the disease and usually throughout the illness the pulse is slow in relation to the

Respiration

Pulse

temperature. Thus with a temperature of 103° F. the pulse may be 90. In nearly all fatal cases the pulse becomes rapid and feeble about the latter part of the second week.

Rose spots

Rose spots probably occur more often than has been reported; they are seen at various periods from about the seventh to the thirteenth day, sometimes in successive crops, the older lesions being darker than fresh ones. The trunk is affected. The spots are about 2 to 4 mm. in diameter, the centre being slightly raised; they fade on pressure, but, if the finger is rubbed repeatedly across them, they become more prominent and are seen to be surrounded by a white halo, which in turn is surrounded by a thin red line. Sudamina are not uncommon, and roseola and erythema occasionally occur. Herpes labialis is present in about 5 per cent of cases. Nausea and vomiting are common early symptoms. Anorexia and constipation are almost the rule and continue throughout the illness. The spleen is palpable in about 5 per cent of cases.

Other skin lesions

Gastro-intestinal symptoms

Nervous system

The typhoid state is common to all severe cases. During the early days the patient is usually bright and lucid, apart from headache and photophobia. Deafness is an occasional early symptom. Insomnia of varying degree, irritability, and restlessness are not infrequent during the first week. Towards the latter part of the first week the patient becomes lethargic, with a stuporose appearance, sluggish speech, and even a latent interval before replying to questions. In a characteristic case of average severity the patient becomes semi-comatose and slips down the bed in a collapsed state. Then, although he is capable of being roused and sometimes responding intelligently to questions, voluntary movements are usually completely lacking. This apathy is out of proportion to the degree of exhaustion present. During this semi-comatose stage there may be incontinence of urine and faeces. Delirium occurs in all except mild cases; it is transitory, only nocturnal, and associated with an exacerbation of fever. Muttering, low moaning, and picking at the bed-clothes are common. Disorientation of time and place frequently occurs, and occasionally there are periods of restlessness and intense excitement, the patient becoming difficult to manage and struggling to get out of bed.

Thrombosis

Thrombosis of the femoral vein occurs in convalescence in less than 5 per cent of cases; it causes a temporary relapse, with rise of temperature and oedema of the affected limb. It takes the usual course and is compatible with recovery. Retention of urine is less often seen than incontinence. Albuminuria may occur owing to the fever, but acute nephritis is not seen. Inflammation of the parotid glands may occur about the end of the second week but it is rare. The swelling usually disappears in ten days or so.

Urinary system

Parotitis

6.–COURSE AND PROGNOSIS

The usual duration of the disease is about two to three weeks. In the first week the patient may feel comparatively well and the clinical picture is that of pyrexia of unknown origin; but at the end of the first week the whole aspect becomes more severe: the patient suffers from headache and profound exhaustion, becomes somnolent and irritable, and may have a cough which persists throughout the second week. Signs in the lungs begin to appear, at first only a few crepitations but later patches of consolidation. During the second week the patient may be semi-comatose, or muttering delirium may alternate with periods of restlessness and violent excitement. At the end of the second week improvement occurs, and the temperature may begin to fall by lysis. In 10 per cent of cases the illness is mild, perhaps with headache, lumbar pain, slight cough, a few rhonchi in the lungs, and fever lasting only five days. *Mild cases*

Mortality The case mortality in the pandemic of 1930 was about 20 per cent, but this figure refers only to the more severe cases, patients with the milder form of the disease escaping notice. In more than one instance the occurrence of a severe or fatal case led to the discovery of milder cases.

Prognosis The prognosis is difficult. The course tends to be milder in the young, but there are exceptions. The condition of the patient during the first few days gives no indication of the ultimate course of the illness. A patient in whom the first stage is ambulatory may be severely ill later on and die. Equally life has been despaired of in the worst stages of the illness in many patients who ultimately recovered. Cyanosis with a high respiratory rate is a bad prognostic sign, but such a patient sometimes recovers. The pulse is very important in prognosis, for, as long as it remains below 100, the ultimate result is almost invariably good. When a rapid pulse-rate develops, the illness attains great severity and may prove fatal. Rigors are of no value in assessing prognosis. Coma nearly always indicates a fatal prognosis, but involvement of the nervous system in any other way is of little value in assessing the chances of death. Abdominal symptoms need not cause serious anxiety, for perforation and intestinal haemorrhage do not occur.

Convalescence Convalescence may be slow and tedious. In all severe cases the condition of the patient is very precarious during the first week of convalescence. At this time the temperature may be subnormal, and the lung signs may persist, the patient feeling worse for a few days. After this progress is usually steady, but in some cases slight relapses occur. Femoral thrombosis may interrupt convalescence.

7.–DIAGNOSIS AND DIFFERENTIAL DIAGNOSIS

In most cases the clinical picture is not sufficiently definite to warrant a diagnosis apart from the history of contact with a sick bird, but, given that fact, the diagnosis with a certain amount of experience is not difficult.

Blood The red-cell count and the haemoglobin percentage remain normal in the average case. In 75 per cent of cases the white-cell count is normal. A leucopenia is present in the remaining 25 per cent. In an occasional case, when there is secondary infection of the lungs by other organisms, leucocytosis occurs. During the first few days of the illness the virus can be demonstrated in the blood. Blood withdrawn aseptically by venepuncture is mixed with an equal volume of 2 per cent sodium citrate in saline, and 1·0 c.c. is inoculated intraperitoneally into each of two or more mice. This method is unlikely to give a positive result after the first week of the disease. Virus is present in the sputum throughout the course of the illness. The sample of sputum should be emulsified in sterile nutrient broth, saline, or distilled water and, after centrifugation or filtration to get rid of bacteria, 0·5 c.c. inoculated intraperitoneally into mice. At necropsy the virus may be sought in the lungs, spleen, or liver. A 10 per cent suspension of these organs, filtered if necessary to remove bacterial contaminants, is injected intraperitoneally into mice. The virus can, at times, be demonstrated microscopically in smears or sections of these tissues.

Virus in blood

In sputum

In post-mortem material

Serological diagnosis

Specific antibodies are present in the patient's serum in appreciable quantity by the tenth day of the disease. The complement-fixation reaction is the most satisfactory test for their demonstration (Bedson, 1935, 1937).

Diagnosis from enteric fever

Clinically the resemblance to enteric fever may be singularly close. The course of the pyrexia, the relatively slow pulse, onset with headache, epistaxis, and sometimes rigors, deafness, apathy, delirium, the typhoid state, bronchitis, abdominal distension, constipation, sometimes vomiting and abdominal pain, rose spots, rarely parotitis, femoral thrombosis, relapse during convalescence, ambulatory cases, and the duration of the illness are all features common to both diseases. The onset of enteric fever is usually insidious, but many cases of psittacosis are of acute onset. The general aching in the limbs which occurs frequently in psittacosis is not characteristic of enteric fever. Except in mild cases of psittacosis, pulmonary involvement is striking and characteristic, whereas in enteric there is usually only initial bronchitis.

The abdominal symptoms of psittacosis are less severe than those of enteric fever, and there do not appear to have been any cases of psittacosis in which intestinal perforation or haemorrhage has occurred. The spleen is palpable in enteric fever in about 70 per cent of cases, in psittacosis in only 3 per cent.

The rashes of enteric fever and psittacosis have many features in common: both appear about the second to fifth day, consist of slightly raised rose-red papules, and come out in successive crops, which after persisting for two or three days disappear, leaving a brownish stain. The spots of psittacosis, however, have round them a white halo several millimetres broad. The rose spots of enteric fever occur in 95 per cent of cases, whereas those of psittacosis so far have been recorded in a very much smaller percentage. The use of laboratory methods of investigation is of the greatest importance: for enteric fever blood culture and later the Widal reaction; for psittacosis the demonstration of the virus in the blood and sputum and later the complement-fixation reaction.

From influenz

Psittacosis and influenza closely resemble each other. Vague pains in the limbs are a common initial symptom in both. Influenza often begins with headache and epistaxis, and a rigor may occur at the onset of pulmonary complications. In influenza, even in grave cases, cough is often absent throughout, and many patients have hardly any sputum. The pulse-rate is raised, but even so it is often slow in relation to the fever.

In fatal cases the course of the two diseases is different. In influenza the patient may be ill for a day or two with mild symptoms and seem to be getting well, when suddenly the whole picture changes, and twenty-four hours later he is dead. There is no such rapid termination in cases of psittacosis, which runs its course, the patient dying during the third week or later. Absence of rose spots in influenza is important in differential diagnosis. Heliotrope cyanosis is a conspicuous feature of influenza in some epidemics; cyanosis is not absent in psittacosis, but when present it is much less pronounced. In influenza the respiratory rate is accelerated out of all proportion to the physical signs, whereas in psittacosis the respirations are usually normal or only slightly raised, even when the signs in the lungs are extensive. In both diseases real respiratory distress is exceptional. Pain in the chest is much commoner in influenzal pneumonia than in psittacosis. The fever in influenza is usually remittent, with evening rise; in psittacosis it is continuous. The constipation and abdominal distension so common in psittacosis are absent in influenza. Whereas in psittacosis stupor and semi-coma are common, these symptoms are absent to the very end in many instances of influenza. In psittacosis suppurative processes are strikingly absent, whereas otitis media, empyema, and meningitis are common in influenza.

8.–TREATMENT

(1)—Prophylactic

The ideal prophylaxis would be strict avoidance of contact with birds, especially parrots. The petting of birds, allowing them to climb up the arm or on the head and shoulders, and feeding them mouth to beak are habits full of danger if the bird is sick, has been recently introduced into the aviary, or has had the opportunity of becoming infected by new arrivals. Overcrowding of birds in cages or aviaries should be avoided and strict cleanliness of cages maintained. Persons looking after birds should always wash their hands after contact with them or anything connected with them. New arrivals in the aviary should be isolated until it is certain that they are not infected. A bird becoming sick should be immediately removed from contact with healthy birds. Strict precautions should be taken with the carcass of a bird dead from psittacosis. Laboratory workers should protect themselves from inhalation of infected material and from contamination of the conjunctiva.

(2)—Symptomatic

Patients must be nursed like cases of enteric fever. Otherwise treatment is symptomatic. Strict personal cleanliness should be maintained by all those attending on patients or touching anything which has been in contact with them. Convalescent serum has been used, but it is difficult to obtain evidence of its efficacy, for sudden spontaneous improvement is not uncommon. The occurrence of relapses suggests that immunity may not always be established early in convalescence.

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PSORIASIS

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Reference may also be made to the following titles:

LICHEN NAILS, DISEASES OF PARAPSORIASIS

1.–DEFINITION

1312.] Psoriasis is a silvery scaling erythematous eruption affecting mainly the scalp and extensor surfaces of the limbs and is one of the commonest skin affections.

2.–AETIOLOGY

Incidence

Sex and age

In England psoriasis accounts for 5 to 6 per cent of all skin diseases. It is prevalent in all classes of the community and affects males rather more often than females. It is rare before four years of age but may arise at any time after that, commonly appearing at puberty. It tends to be chronic and relapsing and often shows seasonal exacerbations. It is less common in warm sunny climates. It is rare in the negro.

Hypotheses of causation

The cause of psoriasis cannot be found in any single aetiological factor. Microbic and parasitic organisms have been repeatedly suggested as the cause, but no credible evidence has been brought forward to support these views.

Metabolic factors

Schamberg found in these patients increased nitrogen retention and advocated a low protein diet. More recently Grütz has laid stress on the presence of increased total serum fats, cholesterol, and phosphatides, and reported good results from the reduction of fats and eggs in the diet. Rost, in an investigation of glucose tolerance in patients with skin diseases, obtained an abnormal curve in 42 per cent of psoriatics. It is probable that these factors are associated but not constant or significant and, as Goldsmith points out, the improvements claimed from such dietetic restrictions may be due to the reduction of total calories in the diets. Van Kerckhoff regards psoriasis as a light-deficiency disease, having demonstrated a diminution of melanin and pigment cells in the basal layer of the epidermis.

Psychological and physiological reactions

Various investigators have insisted on the importance of psychological factors. Whatever may be the true nature of psoriasis, it is helpful and sound clinically to regard it as an inborn peculiarity to react to injury of the skin by psoriasis instead of by the simple erythema with blistering or desquamation which would follow in a normal skin. This tendency varies, and the same stimulus may not always provoke psoriasis or psoriasis of the same degree, and there is no doubt that susceptibility to psoriasis increases at times of physiological instability, as at puberty and the menopause.

Hereditary dyscrasia

Šamberger regards psoriasis as the result of a congenital, sometimes hereditary, weakness or dyscrasia of the keratin-forming cells. A family history of psoriasis is obtained in 20 to 30 per cent of cases.

External factors

The anatomical and circulatory characters of the skin of extensor surfaces and scalp must have much to do with the predisposition of these parts to the eruption, but there can be little doubt that external trauma also plays some part. Localized psoriasis will follow such trauma as vaccination, dog bites, insect bites, the puncture of a hypodermic needle, scratches of brambles, irritation of the skin from constricting clothing, e.g. garters and corsets, and irritant applications, such as chrysarobin. An ordinary exogenic dermatitis, a burn, or irritation from discharges may provoke localized psoriasis. Psoriasis may be seen superimposed upon or incorporated with the reactions of other diseases of the skin of external or internal origin, such as seborrhoeic dermatitis, lichen planus, intertrigo, and, less commonly, eczema and syphilis.

Internal factors

The commonest exciting causes of psoriasis arise from within and act through the blood-stream or sometimes through the nervous system and appear to be mainly blood-borne toxins. An acute generalized guttate psoriasis is almost invariably the sequel of a mild acute infective condition, such as the acute specific fevers, influenza, tonsillitis, quinsy, or other mild infection of the upper respiratory tract, or infections, particularly abscesses, elsewhere. Psoriasis may follow accidents, operations, and nervous shocks or strains. In women pregnancy or confinement may provoke a first attack or be the cause of an acute exacerbation, though whether this is endocrinal, nervous, or toxic in origin is not always clear; probably the endocrine factor is the most important, since puberty and menopausal changes often usher in psoriasis. Occasionally chronic psoriasis clears up during pregnancy. Nervous influences, particularly in adolescence, must not be overlooked. Mental stress and strain, such as examinations, aggravate the disorder, and relaxations and holidays favour remissions; this is true of constitutional reactions in general.

Major illnesses do not tend immediately to provoke psoriasis, and indeed the eruption may disappear, but they may be responsible for the affection later, in convalescence, when the patient has passed the severe stage of the illness and is debilitated.

A rheumatic manifestation

There is much to commend the view that psoriasis is a rheumatic manifestation: the association with infections of the upper respiratory tract, the occasional association with rheumatoid arthritis, and, more important, the response of psoriasis to varying climatic changes. Exacerbations in the spring and autumn, improvement in warmth and sunshine, and the tendency of psoriasis to avoid parts exposed to light must have some significance. In some climates, such as Mesopotamia and parts of Africa, psoriasis is rare, and the most inveterate cases may clear. The various effects of climatic influences on different individuals may in part explain the lack of uniformity in the behaviour of psoriasis.

Keratodermia blennorrhagica

The toxaemia of chronic gonococcal infections occasionally provokes an eruption, keratodermia blennorrhagica, which closely resembles psoriasis and was regarded as psoriasis by Adamson. It is often of the rupioid type though sometimes pustular, and there is much to support Adamson's view.

3.–MORBID ANATOMY

The chief histopathological features are capillary dilatation and oedema of the dermis and oedema, hypertrophy, and thickening of the epidermis. The papillae extend well into the epidermis, and the epidermal interpapillary processes are prolonged into the dermis. Microscopically the papillae, which have penetrated in corkscrew fashion almost to the surface of the epidermis, are seen in cross-section in a greatly thickened epidermis. Leucocytes in large numbers surround the capillaries and infiltrate the epidermis—tunnelling of Civatte—collect in masses as plumes under the horny layer and are cast off as the dry micro-abscesses of Sabouraud-Munro in the scales. The oedema of the epidermis causes cell division and new cell formation in the Malpighian layer (acanthosis) in addition to the normal cell formation from the basal cell layer, and these cells reaching the surface are immature, retain their nuclei, and are but imperfectly keratinized (parakeratosis). As a result they adhere instead of being cast off, and, as they become desiccated, air spaces form between the clumps of cells; these spaces reflect

Acanthosis

the light and are responsible for the silvery-white shining scales of psoriasis; this is emphasized on scratching. It is reasonable to imagine that the dry abscesses become ordinary macroscopic abscesses under exudative conditions and produce the clinical state of pustular psoriasis.

Pustular phase

Psoriasis is entirely a superficial reaction, partly vascular, partly epidermal. It causes some pigmentation of the part affected and heals leaving little or much temporary discoloration but no scar. Psoriasis sometimes causes depigmentation and leaves a leucodermia. Psoriasis does not affect the mucous membranes.

4.–CLINICAL PICTURE

Sites of election

The sites of election of the silvery scaling erythema of psoriasis are the scalp, elbows and knees, and extensor surfaces of the limbs (see Fig. 19); but it may occur on any part of the body. It may be confined to elbows, knees, and scalp, or it may arise in areas which have been damaged and be co-extensive with such injury.

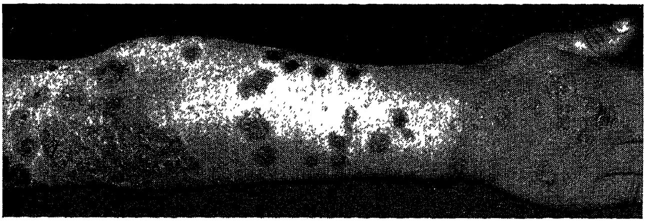

FIG. 19.—Psoriasis of hand and arm

Types of eruption

Itching

Itching is rare, though occasionally it may be severe; questioned about itching, most psoriatics admit some irritation when warm.

Character of lesion

The erythema of psoriasis is somewhat distinctive and can usually be recognized even in the absence of other features; there is an admixture of brown in the red, giving a colour resembling salmon-red. The lesions are always well demarcated, unlike those in most other scaling erythemas. The scaling is considerable; in the scalp psoriasis is readily felt, giving the impression of a miniature mountain range under the fingers by reason of the amount of scale. The silvery-white character of the scaling, readily emphasized on stroking the scale with the finger nail, is perhaps the most distinctive element of psoriasis. If this scale is removed by scraping, the stratum mucosum is reached and is seen as a moist red surface (membrane of Bulkeley) through which dilated capillaries can be seen as red points. These are often abraded in the removal of the scale and leave small bleeding points.

Diagnostic features

All these features, the sites of election, the colour, silvery scaling, the demarcation of lesions, the membrane of Bulkeley, and the capillary bleeding, are peculiarly distinctive of psoriasis and are important aids to diagnosis.

Guttate eruption

The form of the eruption varies widely. Commonly an extensive eruption starts as a number of small punctate lesions scattered over the body—generalized punctate or guttate psoriasis. The guttate lesions may clear spontaneously or respond to treatment and disappear, or they may increase regularly to that of coin-sized discs, nummular psoriasis (see Fig. 20). These small discs may be of the same or of different sizes. Any of them may further proceed to large discoid psoriasis or to extensive plaques. Not uncommonly the lesions spread centrifugally while they clear at the centre, annular psoriasis (see Fig. 21); these ringed lesions may coalesce and form a gyrate or figurate psoriasis. The description of these numerous varieties of psoriasis should not occasion confusion, for the evolution of the pattern is readily understood.

Nummular

Discoid

Annular

Gyrate

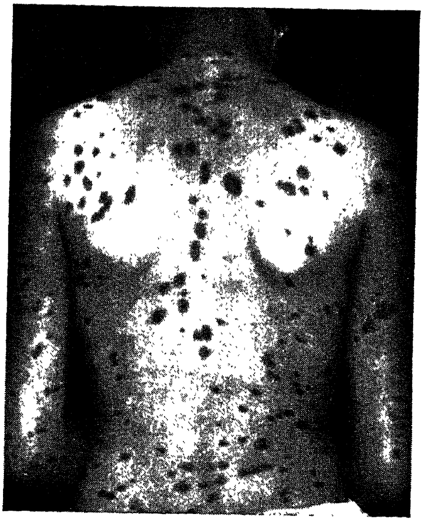

FIG. 20.—Nummular psoriasis

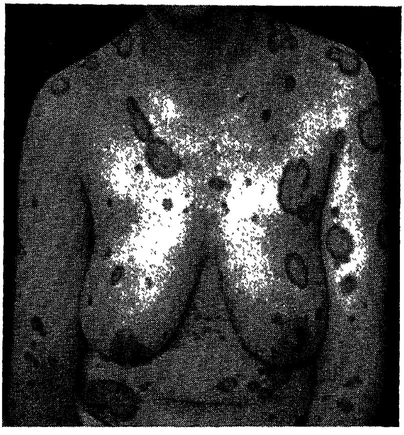

FIG. 21.—Annular psoriasis

In some cases psoriasis is pale and mild, in others it is livid and angry, these features often indicating the severity and giving a clue to the probable response to treatment. Scaling is sometimes slight, sometimes gross, and occasionally so severe as to merit the names ostraceous or rupioid psoriasis (see Fig. 22), the heaped scales resembling the shell of an oyster or a limpet.

Regional psoriasis

On the scalp psoriasis is almost invariably an eruption of discrete lesions with normal scalp between the lesions and not a diffuse affection involving the whole scalp, an important differentiation from seborrhoeic pityriasis capitis. When it affects the whole scalp, the margins are still well defined. It does not cause falling of the hair.

Psoriasis of face

Psoriasis of the face in my experience is common, but this does not appear to be a general experience. Exposure to light probably tends to keep the face clear of psoriasis, and it may be that the light content of the industrial north of England is less than elsewhere in England, and that this is responsible for the fact that there is more facial psoriasis in those districts than in other parts of the country. On the face the condition tends to lose its normal features and rarely has the characteristic colour or scaling. Since the condition is a symmetrical scaling erythema, the differential diagnosis from seborrhoeic dermatitis may not be possible without reference to lesions elsewhere. If markedly erythematous the condition may simulate lupus erythematosus (see Fig. 23).

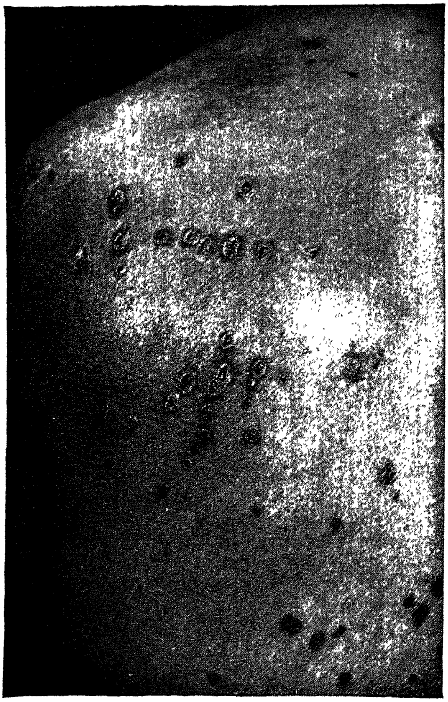

FIG. 22.—Rupioid psoriasis

Of trunk and limbs

On the trunk and limbs a psoriasiform eruption in seborrhoeic sites is recognized and is probably psoriasis provoked by seborrhoeic dermatitis, the result being a mixed reaction often resistant to treatment. Unlike ordinary psoriasis, flexor surfaces are in this type affected more than the extensor surfaces, and the axillae, submammary regions, and umbilicus may be severely affected. In the perineum, groins, and natal cleft the affection tends to be very irritating. In these sites the characteristic colour and the definition and demarcation of the eruption may still be noted. On a number of occasions I have seen psoriasis of the perineum cause great distress, with little or no psoriasis elsewhere; this possibility should be borne in mind in considering the diagnosis of intractable irritable eruptions in this site, for appropriate treatment will usually give relief.

Of penis

Psoriasis of the penis, especially of the glans penis, may present difficulties, and this also may occasionally be seen with few or no lesions of psoriasis elsewhere. Scaling is commonly absent, itching is not pronounced, and the well demarcated persistent red thickened plaque may be confused with lichen planus or with intra-epidermal carcinoma like Paget's disease of the nipple.

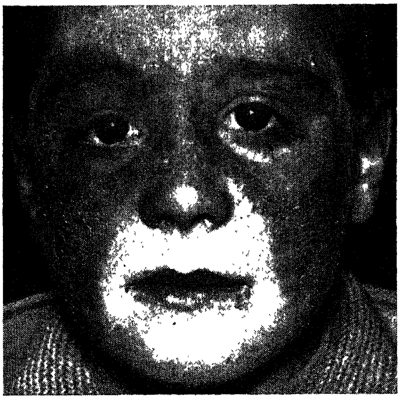

FIG. 23.—Psoriasis of face simulating lupus erythematosus

Of han
and fee

Psoriasis on the hands and feet may assume various forms. It may have the ordinary characteristics of psoriasis, though here it rarely presents much scaling. It may be rather acute, affecting mostly the dorsal aspects and simulating a toxic erythema or an acute lupus erythematosus, and affecting particularly the skin about the nail-folds and dorsal aspects of fingers and toes. This type is sometimes associated with vesication or soddening of the skin in the clefts between fingers and toes. On palms and soles the condition may be diffuse and chronic, giving a general fissured hyperkeratosis of these sites hardly

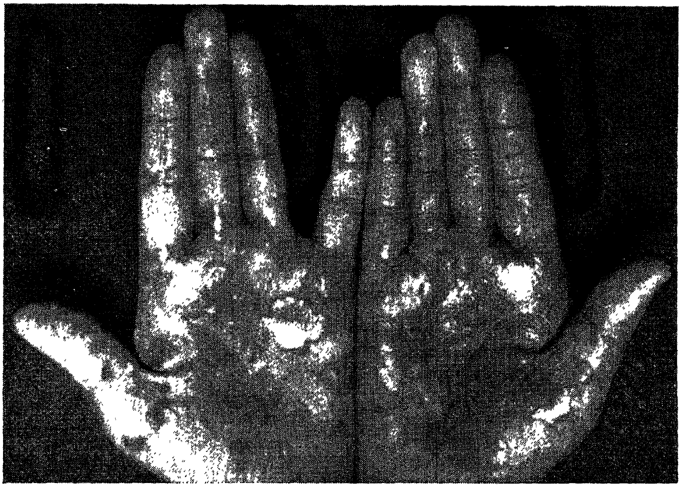

FIG. 24.—Psoriasis of palms

distinguishable from fissured hyperkeratosis from other causes without reference to lesions elsewhere (see Fig. 24). It may occur in these sites as part of a generalized guttate or nummular psoriasis, forming small coin-sized plaques on palms and soles, which give the impression of infiltration and may be confused with secondary syphilis. Comparison with psoriatic lesions elsewhere and absence of other signs of syphilis should establish the diagnosis.

Pustular psoriasis

The development of a pustular phase in psoriasis has been stressed in recent years. The phase is uncommon; it may, in my experience, be provoked by external irritation (as by chrysarobin) or by internal toxic irritation (as from influenza and tonsillitis), though it sometimes appears spontaneously without obvious cause, usually as part of an acute exacerbation. The palms and soles tend to be particularly affected and present small pin-head or larger lakes of sterile pus both in the psoriasis and apart from the psoriatic lesions; these lakes heal and leave small brown spots. Similar lakes of pus may be present in patches of psoriasis elsewhere on the body. The phase calls for complete rest, a search for septic foci and their removal if found, and mild local treatment. In my opinion this is due to the mingling of an exudative eczematous reaction, often of the pompholyx type, with a psoriatic reaction.

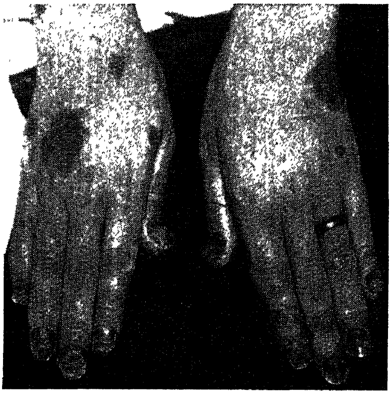

FIG. 25.—Psoriasis of nails

Psoriasis of nails

The nails are commonly affected if the psoriasis is severe, but no one change can be regarded as diagnostic of psoriasis (see Fig. 25). A pin-point pitting of the nails is the commonest and is often best seen when the light is reflected from the surface of the nails (see Vol. IX, p. 89, Fig. 19). This occurs in conditions other than psoriasis, e.g. skin reactions such as in eczema and general disturbances, particularly endocrine-nervous, but its presence with a skin eruption is significant. Furrowing and striation of nails and white dystrophic patches in the nail substance are common. Probably the most important psoriatic change, however, is a general thickening and opacity of the nail-plate with an accumulation of white scales on the nail-bed, the change being most pronounced distally and tending to lift and evert the nail. An important diagnostic point in distinguishing psoriatic nail changes, which sometimes occur without much psoriasis elsewhere, from infection and particularly from ringworm of the nails is that in psoriasis all the nails tend to be affected, the provocative disturbance coming from within, whereas infections tend to involve single nails only.

Generalize
exfoliative
dermatitis

Psoriasis sometimes spontaneously, sometimes as the result of irritant treatment, becomes completely generalized, involving every portion of the integument in a generalized exfoliative dermatitis. In this state the distinctive features, including the silvery scaling of psoriasis, are lost. The linear pityriasiform desquamation with general thickening, oedema, and erythema of pityriasis rubra takes the place of the psoriasis (see Fig. 26). Like all generalized exfoliative dermatitis, this may be serious and fatal, though most patients eventually recover. Without becoming completely generalized and involving every portion of the integument, psoriasis may on occasion spread over wide areas, e.g. the extremities and corset area, losing its characteristics and assuming those of a pityriasis rubra in those sites. When this happens, the condition is particularly resistant to treatment.

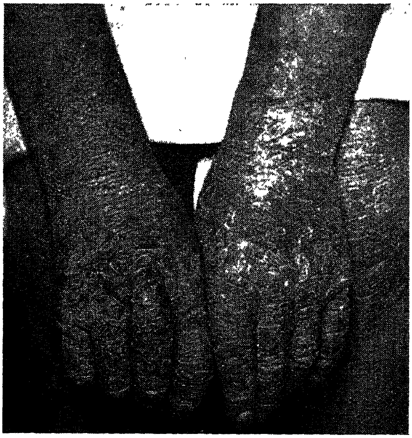

FIG. 26.—Diffuse pityriasiform psoriasis

Arthropathi
psoriatica

The association of a very resistant type of psoriasis with rheumatoid arthritis—arthropathic psoriasis—is well recognized; it is not particularly amenable to gold therapy as might be expected from the good response of the arthritis to this measure. The psoriasis here tends to be of the acute livid type and calls for mild treatment. The hands and feet are usually involved. Psoriasis tends to avoid a limb paralysed from acute poliomyelitis.

5.–COURSE AND PROGNOSIS

The prognosis varies with the individual. To some extent the family history and past history are relevant; the general health is probably more significant and must be considered in relation to the patient's work and environment. Just as the severity and extent of psoriasis may vary widely, so may its course and response to treatment. The condition may consist of a few lesions on extensor surfaces or scalp or be a generalized, more or less profuse, eruption; the lesions may be shallow and amenable to treatment or thick and resistant, acute or subacute irrespective of duration, or chronic and indolent.

To some extent prognosis depends on prompt and efficient treatment of each attack, particularly the first, and on after-care. Response to treatment and the maintenance of freedom after efficient treatment give some indication of the probable future course, but a troublesome phase during puberty and adolescence does not necessarily mean that the patient will be a lifelong sufferer. Climatic sensitiveness (see p. 189) should be considered.

Response to treatment

After a first attack a patient may remain clear indefinitely and perhaps for life. More commonly relapses occur sooner or later, and the course tends to be chronic and relapsing. A few patients have the greatest difficulty in remaining free from the eruption for any length of time.

Psychological factors

Psoriasis is susceptible to psychological influences, and the suggestion that the patient has an incurable affection may materially worsen the course of the disorder. On the other hand, a confident and efficient management of the attack may dismiss serious consideration of its subsequent behaviour from the patient's mind with beneficial effect (see p. 199).

Complications

Carcinoma and mycosis fungoides are very rare complications.

6.–DIAGNOSIS AND DIFFERENTIAL DIAGNOSIS

Reference has been made to diagnosis and differential diagnosis in the description of the clinical phases, particularly when dealing with regional psoriasis (see p. 190).

In the scalp the circumscribed character of the lesions with normal intervening skin is so prominent that the diagnosis is readily made by touch; on palpation, psoriasis of the scalp gives the impression of a miniature mountain range.

From seborrhoeic dermatitis

Being a scaling erythematous eruption psoriasis must be differentiated from such general eruptions as seborrhoeic dermatitis and pityriasis rosea and occasionally from dry scaling patchy eczema and from ringworm. Rarely will the distinctive features of silvery scaling, salmon-red erythema, and the definition and demarcation of the lesions fail to stamp the diagnosis of psoriasis. The other four affections have none of these features. Seborrhoeic affections are most marked on the flexor aspects of limbs, whereas psoriasis affects extensor surfaces, and pityriasis rosea is generally confined to the trunk, not affecting the limbs to any degree. In both these affections scaling is slight and pityriasiform (bran-like).

From pityriasis rosea

From scaling ringworm

Scaling ringworm lesions of the skin are well defined but are irregularly disposed, rarely affect psoriatic sites (except the scalp), and do not present the heavy silvery scaling of psoriasis.

From eczema

Patchy shallow scaling eczema has not the silvery scale and does not usually choose psoriatic sites, and the pin-head elementary lesions of erythematous or papular eczema will often be present somewhere.

Lichenified circumscribed eczema and lichen simplex chronicus often affect the extensor ulnar borders of forearms and the knees; these may be well defined but are intensely irritating, are more violaceous than red, and have not the scaling characteristic of psoriasis. The moist membrane of Bulkeley (see p. 190) cannot be demonstrated on removing the scale, but the differential diagnosis here may be difficult. *From lichen simplex*

Lichen planus affecting psoriatic sites may suggest psoriasis. If there is no lichen on typical sites, including the buccal mucosa, the diagnosis may be difficult. The colour, the itching, the burnished appearance in reflected light, and particularly the infiltration of the lichen papule will usually indicate the diagnosis. *From lichen planus*

Both secondary and tertiary syphilis may provoke psoriasiform lesions. In secondary syphilis a sore throat, the presence of lesions on mucous membranes, general adenitis, and the absence of itching should be noted. The eruption will be polymorphic in most cases, the macules, papules, and scaling, crusted, and condylomatous lesions possibly being present; but the essential feature is the infiltration of the syphilitic papule. The Wassermann reaction of the blood is positive. In tertiary syphilis differentiation may not be so easy. Both tertiary syphilis and psoriasis tend to give circinate lesions, but in the former it is usually a solitary unilateral lesion, which is definitely infiltrated. A Wassermann reaction will confirm a suspicion of tertiary syphilis in 90 per cent of cases, and the response to therapy will quickly remove any doubts. *From syphilis*

7.–TREATMENT

The treatment must be considered from a number of aspects, including the age and circumstances of the patient, the type, duration, and severity of the eruption, and the personal and family history. Further, the treatment of the attack and the after-treatment of the patient must be considered.

The local treatment is the more important, and here tar is the chief agent. It may be employed in the form of tar baths, paints, or ointments, or pure tar may be applied to the skin; ointment therapy is the most effective. *Local treatment* *Tar* *Ointments*

It is important that the patient should take a hot bath, if possible a tar bath (i.e. solution of coal-tar, 4 to 8 fluid ounces to 30 gallons of water), and wash the affected parts with soap to soften and remove scales immediately before the vigorous inunction of ointment. Cyllin can be substituted for solution of coal-tar in the bath. A reasonably clean and effective standard ointment is the following:

Solution of coal-tar – – – –	30 minims
Ammoniated mercury – – – –	10 grains
Soft paraffin – – – – –	to 1 ounce

It is much more effective though much more dirty to use if 20 grains of prepared coal-tar are substituted for the solution of coal-tar. If there is much scale, 10 grains of salicylic acid may be added: it is often of value apart from its keratolytic effect.

Mercury and tar

Various combinations of mercury and tar ointments are used; MacKenna recommends equal parts of the following ointments: dilute mercuric nitrate, tar, salicylic acid, and glycerin of lead subacetate.

Chrysarobin

Chrysarobin is not so commonly used now, though it is an effective remedy. It may be used in the same manner as tar in the strength of 20 grains to one ounce of soft paraffin, or in the tar and mercury ointment described above. It is a vigorous irritant, must be kept away from the flexures, and must not be used on the scalp or face, because it will discolour the hair and cause conjunctivitis. It provokes an erythema, stains the normal skin purple, and burns off the psoriasis to leave the skin in these sites white. It rots linen and stains it purple, and in practice it is wise, if chrysarobin is used, to have the patient confined to bed.

Cignolin

A proprietary preparation cignolin, which is stated to consist of dioxyanthranol, has to a great extent taken the place of chrysarobin. It is used in a strength of 1 grain increasing to 4 or 6 grains to one ounce of soft paraffin; it is effective in much the same manner as chrysarobin but is less irritant, stains less deeply, and does not rot linen. If used in a tar and mercury ointment such as that described above, it is more effective but unstable, being rapidly reduced, and must be dispensed afresh every few days. In common with most dermatologists, I recommend cignolin as the most effective local remedy available and always prescribe it in the tar and mercury ointment described above. It is suitable for use on the scalp and has not the disadvantages of chrysarobin. When using chrysarobin or cignolin it is desirable to give a thorough and vigorous course of treatment in bed. It is customary for the patient to have a hot bath daily and to have the ointment thoroughly rubbed into the skin by hand or with a glass rubber twice a day. A course of two to three weeks' duration will commonly clear off the eruption; during treatment the psoriasis clears and leaves white depigmented patches set in the surrounding erythematous and lilac-tinted skin. The treatment is suspended when these white patches become slightly erythematous. The effect of treatment can be increased and the course shortened by avoidance of baths until the acute reaction has set in or by exposing the patient to sub-erythema doses of ultra-violet rays before applying the ointment.

Tar, chrysarobin, or cignolin may be dissolved in benzene, chloroform, or gutta-percha solution and painted on the skin, but this form of application is not very effective.

Oil of cade

Oil of cade (juniper-tar oil) is a most effective measure for the scalp in the strength of 60 minims to one ounce of soft paraffin, with or without salicylic acid. If patients object to the use of ointment on the scalp, solution of coal-tar, full strength or half strength, may be brushed into the affected parts of the scalp with a tooth-brush. With either treatment the scalp should be shampooed once or twice a week.

A suitable ointment for the scalp is the following.

Salicylic acid	10 grains
Oil of cade	60 minims
Soft paraffin	to 1 ounce

The following is a suitable shampoo.

Soft soap	½ ounce
Industrial spirit	120 minims
Distilled water	to 1 fl. ounce

Emulsifying bases

There is a tendency to use bases which, by forming effective emulsions with the secretions of the skin, afford penetration of the drug prescribed and are easily removed by washing. There is not as yet sufficient evidence for estimating their full value, but it is likely that they will be used widely as ointment bases in the treatment of such conditions as psoriasis, particularly on the scalp, where great difficulty is experienced in ridding the hair of soft paraffin. Triethanolamine is such a preparation and can with advantage be added to the above ointments in the proportion of 60 minims to one ounce. Mumford recently described Halden's emulsifying bases (H.E.B. simplex) for the same purpose.

An effective treatment is painting the skin daily with Stockholm tar or with prepared coal-tar, the patient lying in a hot bath afterwards to help the tar to penetrate into the skin. Equal parts of birch-tar oil and alcohol are used in Denmark, and a bath is taken fifteen minutes after the application.

If the eruption is extensive, thorough treatment generally necessitates that the patient should be confined to bed.

Radiation therapy

In my experience the most pleasant and the most effective treatment of psoriasis is general irradiation with ultra-violet rays daily to the whole body in erythema dosage (though sub-erythema dosage is often effective), administered immediately after a hot tar bath (see ACTINOTHERAPY, Vol. I, p. 190). At night the patient should apply a little tar and mercury ointment to hasten removal of scales, but there should not be any ointment on the skin during its irradiation. This treatment is effective, no doubt, partly by reason of its local and partly by its general effect, and three to four weeks will generally clear an extensive eruption. It seems more effective when administered in conjunction with infra-red radiation (see HEAT, RADIANT, Vol. VI, p. 394).

Sufferers from inveterate psoriasis, if they cannot reside in those climates in which psoriasis tends to disappear, will often keep clear or relatively clear by exposing themselves to ultra-violet rays daily or occasionally as part of their toilet routine. The exposure should be made after the bath and should be insufficient to produce erythema; the practice can often be discontinued during the summer.

X-ray therapy

X-rays should be prescribed for psoriasis in special cases only and by a dermatologist. They are generally best avoided, but in some very limited or obstinate cases their use is justified, though some authorities believe that relapses after X-ray therapy are less amenable to treatment than would otherwise be the case. Lomholt claimed good results from the use of his special radium emanation plates, a very mild form of radium therapy. Borderline (Grenz) rays are also said to be of value in the treatment of resistant psoriasis.

Grenz rays

Internal treatment

Apart from such symptomatic treatment as may be indicated for sepsis, anaemia, debility, nervous instability, endocrine derangements, or gastro-intestinal disorders, general treatment is not of great importance. For acute psoriasis salicylates are recommended, because most acute cases are secondary to infections for which the salicylates are of value; some cases of chronic psoriasis, however, especially those with a mild rheumatic tendency, are benefited by salicylates.

Arsenic

Signs of intolerance

Arsenic benefits chronic psoriasis but should not be used freely. Most chronic cases respond well to the drug at first, but it does not prevent relapses, and response to treatment diminishes in spite of increased dosage. There is serious risk of chronic arsenical intoxication, even of arsenical cancer, if the drug is continued for long periods, and there is very little benefit to the psoriasis. If used at all it should be prescribed in a course lasting a few weeks, Fowler's solution being given in 1-minim doses thrice daily after food, the dose being gradually increased by 1 minim every second day to 10 minims thrice daily or to the point of tolerance, then being gradually reduced at the same rate. Intolerance may be shown by dryness of the throat, smarting and redness of the eyes, abdominal pain, sickness or diarrhoea, and slight oedema of the face and extremities. It is often wiser to give the course by injection using mercuric salicylarsonate (enesol), giving ½ grain intramuscularly once or twice a week to a total of 6 grains.

Mercolloid

Mercolloid, a colloidal sulphide of mercury, given intramuscularly daily or on alternate days in a dose of 1 to 2 c.c. for twelve to twenty injections, is sometimes of value in chronic cases.

Endocrine therapy

In puberty, menopausal, and pregnancy cases dried thyroid ½ grain thrice daily or other endocrine therapy is occasionally effective.

Other drugs

It is doubtful if any other drugs, such as ichthammol, manganese, phenobarbitone, are of certain value, and I suspect that, as in the treatment of warts, their occasional effect may depend on psychological rather than on medicinal factors. Many psoriatics show some mild degree of physiological instability which probably adversely affects the psoriasis. This instability may be helped by phenobarbitone ⅛ grain twice daily after food, which, in this way, is indirectly of value in dealing with the psoriasis.

Gold

Occasionally psoriasis responds well to the injection of gold salts, but they have not when given by the mouth been of much value in my hands. They must be used with care and in small dosage, as for lupus erythematosus (see LUPUS ERYTHEMATOSUS, Vol. VIII, p. 252).

General principles

It is reasonable with our knowledge of psoriasis to suppose that some degree of habit may exist, and that the less a patient suffers from psoriasis the less will be his tendency to that reaction. First attacks, particularly in children, should be treated promptly and thoroughly; as a general rule the patient should be put to bed and the eruption completely cleared, as can invariably be done in two to three weeks. Rest in bed greatly facilitates recovery, apart from the fact that treatment can be so much more efficiently performed. Wide-spread attacks should therefore be treated in bed and completely cleared.

There are all degrees of affection and of susceptibility. Inveterate cases which relapse readily in spite of efficient treatment are well advised, as has been indicated (see p. 199), to secure regular ultra-violet irradiation. This must, however, be done efficiently and not in the casual and useless fashion practised by many non-medical therapists. The installation of a lamp in the home, the patient being properly instructed, generally proves most effective and adds very little to the toilet routine of the day. If light treatment is not possible, these chronic cases should be cleared of psoriasis once or twice a year by a course of treatment in bed lasting usually two or three weeks. It is certainly desirable that severe and resistant cases should reside in those warm and sunny climates which tend naturally to cure psoriasis, e.g. Egypt, Mesopotamia, Kenya, and South Africa.

Treatment of scalp

Constant attention to the scalp is important, and a mild tar therapy can be regularly used here in the form of pomades, lotions, and shampoos. (See previous note about emulsifying bases on page 199.)

Mercuric chloride	$\frac{1}{4}$ grain
Solution of coal-tar	20 minims
Resorcinol (or eureso 10 minims)	10 grains
Industrial spirit	180 minims
Lavender water	q.s.
Distilled water	to 1 fl. ounce

The lotion to be applied to the scalp daily.

Solution of coal-tar	30 minims
Soft soap	$\frac{1}{2}$ ounce
Industrial spirit	120 minims
Distilled water	to 1 fl. ounce

The shampoo to be used once a week.

Salicylic acid	5 grains
Solution of coal-tar	10 minims
Coconut oil	120 grains
Lavender water	q.s.
Soft paraffin	to 1 ounce

The ointment to be applied to the scalp occasionally.

It is, finally, most important that psoriatics should be healthy physically and mentally. The importance of care of teeth, nose, and throat, removal of foci of infection, and attention to the bowels cannot be exaggerated, for focal infections most readily provoke the reaction. Adequate rest and holidays, the maintenance of nervous and mental tone, and avoidance of undue stress and strain are most desirable.

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PSYCHASTHENIA

See PSYCHONEUROSES AND PSYCHOTHERAPY, p. 232

PSYCHIATRY OF CHILDREN

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Reference may also be made to the following titles:

CHILD GUIDANCE
INTELLIGENCE TESTS
MENTAL DEFICIENCY
NIGHT-TERRORS
PSYCHOANALYSIS
PSYCHONEUROSES AND PSYCHOTHERAPY
PSYCHOPATHIC PERSONALITY
PSYCHOSES

1.–DEFINITION

1313.] Child psychiatry comprises the study of all the disorders of mind and behaviour of children, whether primarily physical or primarily psychological in origin. The subject therefore borders on general pediatrics and neurology on the one hand and psychopathology on the other.

The study of the child as a whole is the only line of approach which can give a complete insight into the nature of child behaviour, from the simple day-dreaming and irritability of temper to the complex disorders which arise from gross disease of the nervous system. An all-inclusive definition should take in the mental deficiencies, the mental sequelae of meningitis and epidemic encephalitis, the congenital disorders of the nervous system which involve mental changes (such as cerebral diplegia), Huntington's chorea, and Sydenham's chorea.

2.–AETIOLOGY OF DISORDERS OF CHILDHOOD

In recent years team-work on disorders of childhood (child-guidance clinics) has shown how many social as well as medical fields must be explored for the discovery of causal factors. Behaviour disorders known to parents may be unknown to school teachers and vice versa; and a policeman may discover delinquencies unknown to either.

A disorder of behaviour may be discovered by an educational psychologist who, while investigating an intellectual handicap, discovers its emotional repercussions or its emotional origin. The psychiatrist may explain to the educationalist why the child has difficulty in learning, and the dietitian may show how disordered metabolism may occasion a behaviour disorder. It is clear that there is a bewildering number of disorders which come within psychiatric practice.

3.–CLASSIFICATION

The following classification of the disorders of childhood, based solely on signs and symptoms, may prove of value.

Subjective disorders

(i) Subjective disorders or such disturbances of mental function as depression, shyness, solitariness, day-dreaming, irritability—only felt by the child and not necessarily patent to the observer—overt anxiety, fears or phobias, obsessions, night-terrors, compulsive acts, and sleep-walking; intellectual and educational defects, such as general backwardness and special disabilities in reading, writing, and arithmetic (including visual and auditory imperceptions).

Objective disorders

(ii) Objective disorders or disorders of conduct which disturb others in various ways. These include 'bad habits', such as masturbation, fidgeting, nose-picking, thumb-sucking, nail-biting, and clothes-picking; temper, tantrums, destructiveness, cruelty, rebellion, and delinquencies, such as lying, stealing, wandering, and truancy; sexual offences against others; and the succumbing to sexual stimulation by others.

Combined subjective and objective

(iii) Combined subjective and objective disorders which have been described as the neurotic accompaniments of behaviour disorders and delinquencies.

(iv) Mental aberrations, which may fall into the same nosological groups as are dealt with in adult psychiatry, such as hysterical manifestations, including convulsions, hallucinations, ideas of persecution and other delusions, feelings of unreality and depersonalization, the shut-in personality of dementia praecox, and profound depressions, which fortunately rarely go on to suicide or attempts at suicide.

Mental aberrations

A mere descriptive catalogue, however, is of little value except for the statistical purpose of ascertaining the incidence and distribution of forms of disorder in the child and adolescent population. It does not throw any light on causation and little on prognosis. An isolated symptom may appear trivial yet from a psychiatric point of view be of grave import, and a syndrome of three or four symptoms and signs may indicate a minor anxiety state or grave character anomaly. Persistent solitariness may give grounds for a graver prognosis than outbursts of rage that upset a family.

Significance of symptoms

From the point of view of medical practice, the mental sequelae of physical disorder call for initial attention. Such conditions naturally come to the neurologist and the pediatrician, inasmuch as the physical signs overshadow the mental symptoms. This is true of a fair sample of post-encephalitic cases with a clear history of a febrile attack and focal neurological signs, however transitory; and meningitis with positive cerebrospinal fluid findings, juvenile tabes, chorea with a clear rheumatic history, amaurotic family idiocy, epiloia, mongolism, cretinism, familial disorders of the muscular system with mental accompaniments, cerebral tumour and abscess, and progressive lenticular degeneration all present sufficient physical signs to put the associated mental trouble in a clinically subordinate position to the physical.

Sequelae of physical diseases

The above diseases are not always clinically defined by physical symptoms; the mental and behaviour aspects may be the first and only manifestations of impending disease. For example, many behaviour disorders may pass as purely psychological, until a history of encephalitis or meningitis is forthcoming. A sudden or insidious change in the character of an otherwise normal child in the absence of a provocative cause in family, school, or social conditions should always suggest post-encephalitis or congenital syphilis. When, however, the change takes place in adolescence, even in the absence of provocative factors, the emergence of a psychosis, such as dementia praecox, must be considered.

Furthermore, the protean disorder or reaction called hysteria can simulate almost any organic disease, and, although in early childhood clear-cut hysterical reactions are rare, from the age of three onwards disorders of motility, sensation, and visceral function may be due entirely to hysteria, even if some minor physical irritation is discovered.

Hysteria simulating organic disease

Enlarged or inflamed tonsils, adenoids, oral sepsis, untreated ocular defects, spinal malformations, flat-foot, and even intestinal parasites can all be regarded as possible irritants which release mental peculiarities. Only a statistical inquiry will be able to show what types of mental reaction are liable to result from a specific physical handicap. Tonsillar infections and the like are prone to cause mental hebetude or irritability

Other physical handicaps

of temper. Postural defects are often associated with emotional retirement in some children and truculence in others. Early abdominal disorders, such as coeliac disease and tabes mesenterica, are found to produce, years after recovery has taken place, not only a general stunting in growth but a type of mental attitude popularly equated with feelings of inferiority and the effort to compensate for them.

4.–CLINICAL FORMS

(1)—Part Reactions

Although mental disorders tend to disturb the organism as a whole, i.e. total behaviour is disordered, many conditions due to a general psychological disturbance appear clinically as part reactions, i.e. special regions or organs of the body appear to be particularly, sometimes exclusively, affected. Not only may special functions, such as speech, special senses, motility, and sleep, be adversely affected, but a particular limb and a particular organ may bear the brunt of some underlying mental disturbance. Although clinical examination may not reveal any structural defect, the function of the particular system or organ is disturbed.

Respiratory disorders

Disturbances of respiration may include persistent coughing, asthma, excess of sputum, and tricks of breathing such as gasping, sighing, and holding the breath to the point of unconsciousness and even convulsions.

Cardiac

Functional cardiac disorders are extremely rare in childhood; only adults, aware of the vital function of the heart, select palpitations and precordial pains as the basis of a phobia or of a hypochondriacal self-centredness.

Gastro-intestinal

Non-organic gastro-intestinal disorders include anorexia to the point of extreme wasting, spasm in deglutition, eructations, air-swallowing, and vomiting. Abdominal pain may result from frustration and fear of having swallowed an object or substance to which some imagined evil has been attached. Obstinate constipation is bound up with emotional dispositions, and incontinence of faeces may be due to a return to an infantile lack of control as well as to the absence of the habit of control.

Urinary: enuresis

Urinary disturbances show themselves in the outstanding disorder, enuresis (see Vol. V, p. 77).

Circulatory

Circulatory disturbances in children without known organic or metabolic causes may be persistent, seasonal, or episodic. Spasm of the vessels of the hands and feet suggests a constitutional arterio-autonomic peculiarity, and the fact that children of a certain psychological make-up are prone to this disorder does not warrant in all cases a belief in psychogenesis only. Children with cold or even blue hands or feet are often morose, locked-in, and sometimes resentful; they possess an apparent air of docility but are often bad-tempered and dissatisfied with themselves and others. Such children may occasionally develop dementia praecox in adolescence and later. On the view of psychosomatic unity, body and mind are so closely linked that in such cases causal priority cannot always be determined.

Pallor, nausea, and faintness

Sudden pallor occurring together with feelings of nausea and faintness makes a diagnosis of the cause extremely difficult. The conception of spasmophilia has been evoked, and even an epileptic diathesis has been suggested. Acidosis may explain those cases which respond to glucose and alkalis; but, while there may be a transient acidosis which is relieved by such treatment, emotional disturbances which affect metabolism may be cut short by this treatment but not necessarily cured by it. Careful examination of the situation in which the attacks occur often reveals a clear emotional factor. A few cases of this type do not show associated emotional disposition, and, although a constitutional metabolic foundation is present, psychotherapy has often strikingly diminished both the frequency and the intensity of the disorder.

Neuromuscular

Neuromuscular disorders connected with mental disorder include a number of tics and so-called habit spasms. Without reference to psychology, neurology cannot explain the emotional undercurrents which occasion many of these tics. Nail-biting, grimacing, nose-picking, and genital manipulation are emotional habits and can only be understood and rationally treated in the light of total emotional disturbances of the personality. Cerebral localization cannot explain habits which are so capricious and yet so privately purposeful. They depend on character deviations or on the frustration of some instinctual activity or on its overflow in a substituted field. Conditions so amenable to psychotherapy and even to management can hardly be attributed to trouble in the basal ganglia or to lesions of the strio-pallidal system. In the absence of clear-cut neurological signs, such neurological explanations are at best purely academic.

(2)—Whole Reactions

After the physical symptoms of the child have been analysed, inquiry must be made into his or her psychological make-up. The numerous symptoms and signs fall in some measure into patterns or syndromes, but these syndromes bear little likeness to the symptom-complexes of organic disease, except when hysteria closely simulates an organic condition.

The elements of a non-organic syndrome are closely related to the expression of emotional stress. For example, sudden pallor and cold perspiration are part of the picture of fear, and sudden pains in the stomach associated with vomiting may indicate a state of anxiety. Further, viewing such symptoms in the light of a specific occasion will partly elucidate the cycle of stimulus and response; but even such stimulus and response situations recognizable as emotional still are but part reactions; whatever be the non-organic part reactions, psychological investigation of each case can alone reveal their significance.

These reactions can be explained only by examining the psychological structure of the child's mind, the part played by and destiny of his instinctual needs, and the way in which these have been moulded by his earliest experiences. When a physical survey has shown that mental factors have entered into the clinical picture, the practitioner must change his approach and study the total personality of the child, firstly as presented in a cross-section and secondly as the history of a developing mind struggling for satisfaction and breaking down in the course of attempted adaptation. The practitioner now views the child not solely as a neuro-metabolic machine but also as a feeling, thinking, and striving human being whose basic instinctual needs have been disturbed and his relations to the external world consequently distorted.

The study of mental deficiency is concerned mainly with the thinking (cognitive) or intellectual handicaps, largely because intelligence rather than any other function seems to suffer. Both the emotional life and behaviour are disturbed in consequence, but the large body of child psychiatric conditions, although manifest in symptom and behaviour, are mainly emotional; any associated intellectual impairment is a sequel of emotional difficulties, and in most of such cases the intellectual capacity is usually well above the statutory level of mental defect (intelligence quotient 70).

5.–METHODS OF DIAGNOSIS

(1)—Psychiatric Examination

This is an inquiry into the nature of the basic mental functions and to discover whether or not these are abnormal. Mental tests are carried out to determine the intellectual level of the child. In a rapid investigation certain crucial tests can be used, and, if the child is found to be relatively normal, a detailed study of intelligence is unnecessary. (See INTELLIGENCE TESTS, Vol. VII, p. 210.)

Intelligence tests

Verbal and performance tests

Should there be any doubt about the presence of a specific disability, full tests, verbal and performance, are carried out to discover whether or not the child is suffering from some type of aphasia which limits intellectual output. Performance tests will indicate whether or not, despite the child's language imperfections, he still possesses intellectual powers which can be displayed in performances which call for an understanding of non-verbal reasoning. It is then necessary to investigate the child's perceptions by tests of sensory appreciation and the recognition of simple visual and auditory experience. The emotional make-up of the child is investigated through a study of its demeanour during the interview and from an account given by a parent about the child's everyday conduct and emotional tempo. Such an inquiry is usually not carried out in a formal way except for the special purposes of research, but the story obtained of the child's relations to others gives the practitioner the required information.

Sensory and emotional examination

The presence or absence of anxiety-moods, fears, phobias, and obsessions indicates the severity of the disorder, and an inquiry into the child's sociability at home and at school and into the degree to which it manifests love, hatred, dependency, freedom, jealousy, and social feeling gradually fills out the picture of a disturbed personality and affords clues about the causes of maladjustment.

The presence or absence of more malign or psychotic processes is indicated by inquiry into the integrity of the child's continuous conscious life. Are there moments of clouded consciousness? Lapses of consciousness? Rambling and incoherent speech? Periods of day-dreaming and indifference to external events? The practitioner should inquire about the presence of disturbed perception manifest as hallucinations by day and night-terrors during sleep. Furthermore, it is necessary to discover whether or not there have been distortions of judgement or delusions. Does the child exhibit undue suspicion? Does he think he is unfairly treated, or that people talk about him? Does he resent being looked at, and does he adopt an attitude of hostility towards particular persons or to people in general without adequate reason? Does the child suffer from moods of excited gaiety on the one hand and depression on the other? Is he self-depreciative and overwhelmed by a sense of unworthiness or guilt? Has the child morbid ideas about the workings of his own body? Even in children hypochondriacal preoccupations in the absence of anxiety may be warnings of the masking of psychotic trends.

Disturbances in character

Such a cross-section of the child's mental make-up gives an insight not only into causes but into prognosis. Apart from such gross psychological disturbances, the investigator must also look for disturbances in character, because the study of adult psychotics and neurotics has shown that in their childhood there may have been no clearly defined signs of neurosis or psychosis, but there were disturbances in character. These are shown by lack of sociability, indolence, shyness, lack of power to play alone or in company, and excessive goodness, as well as by intractableness of temper. A constellation of such character peculiarities may sometimes have a graver import than actual neurotic symptoms.

(2)—Psychopathology

History of case

The second, yet essential, investigation of a child's mental disorder is the close scrutiny of the historical development of symptoms and behaviour. When this is carried out, the practitioner is in a position to discover the time when mental divergences have taken place. Divergences from the normal begin in the earliest months of life, for it is during infancy that the loosely tied bundle of instincts with which the child is endowed comes to be sheaved together in order that he should acquire the pattern which the parental attitude towards human behaviour imposes upon the instinctual life of a child.

First, the bodily functions suffer limitation at the hands of mother and nurse. Sucking, sleeping, and elimination are subject to regulation, and, although the child is neurologically endowed with a capacity for suffering the conditioning of its unconditioned responses, he does so to some extent grudgingly; and, when these processes have been mismanaged or have been controlled too harshly, the struggle by the child for self-assertion merely incubates aggressive responses. Later, when the child becomes aware of the outside world, he begins to develop love responses towards those who satisfy his needs; the management of these responses produces the tangle of love and hate which lies at the basis of future emotional disorders. As the child grows older, his relations to his parents invested in the love, fear, and respect which he bears them form the substratum of conduct and the basis of moral behaviour, and the struggle to be good alongside the struggle to be free becomes the nuclear conflict, escape from which is frequently achieved along the abnormal path of neurotic and psychotic reactions. (See also PSYCHO-ANALYSIS, p. 213; PSYCHONEUROSES AND PSYCHOTHERAPY, p. 232; PSYCHOPATHIC PERSONALITY, p. 260; and PSYCHOSES, p. 266.)

6.–PROGNOSIS

In psychological medicine both diagnosis and prognosis are often made clear only after treatment has been in operation for some time. It is generally held, and with justice, that the prognosis of behaviour disorders and mental disorders is better in childhood than in maturity, because the mind is still plastic.

When there is a poor family history, it is always wise to give a guarded prognosis and to promise at most a modification rather than a radical change of mind and behaviour in the child. Prognosis in childhood depends to a large extent on the goodwill and co-operation of the parents, with whom the child usually continues to live and with whose reactions he must also react. Moreover, the parents are so intricately bound up with the causes of the child's disorder that they must accept the child's neurosis as in part a reaction to their parental attitude.

Apart from this consideration, however, the child's mental make-up also determines the ultimate prognosis.

So fundamental a disorder as psychosis, of which the insanities of adult life are more clear-cut and intractable mental disturbances, presupposes a tangle of emotional processes based upon organic constitutional foundations. Therapy can rarely hope to alter these deeply established trends already woven into the child's mind; but sometimes, in selected cases, the patience of parents and doctor, if applied over long periods, will help many children to adapt themselves to the world or at least to live happily in a carefully selected environment.

Apart from clear-cut psychotic reactions, the large number of everyday neuroses call for prognosis. The majority of minor disorders of behaviour clear up with sane management suggested to parents by the trained practitioner. More deeply seated troubles, obsessional behaviour, timidity, rebellion, and phobias call for psychotherapy, which gives good results so long as parents do not expect sudden cures. Every child patient must be made to realize that the neurosis is a reaction to some frustrated instinctual need which the necessity of upbringing curtails. Some children have less capacity to accept frustration than others. In such cases the prognosis is less hopeful. When a child possesses special capacities or is trained early in life to accept and to enjoy the society of other children, the neurotic reactions are overcome by sublimation and by the diffusion of hate and love feelings over a wider human field. In these conditions the prognosis can be generally satisfactory.

7.–TREATMENT

In some measure it is true that only in treatment is diagnosis of mental disorders really possible, for, inasmuch as through the treatment the mental mechanisms of the neurosis are laid bare, it is only then that a diagnosis can be made of the processes at work and the probable outcome of such processes, namely, cure, chronicity, or deterioration.

Usually in cases diagnosed early the essential cause can be soon discovered, and in very many it can be seen how parental mismanagement or gross environmental difficulties have been responsible for the symptom. Guidance to parents and the removal of environmental stresses restore many children to normal mental health and behaviour (see CHILD GUIDANCE, Vol. III, p. 125), but cases remain in which the causes of the condition lie hidden in the tangle of unconscious conflicts within the child's mind, which the symptoms disguise. The flight into illness is a retreat from these unconscious conflicts, and special technique must be used in order to elucidate the causes. This discovery is not an intellectual achievement but a release of emotional tension which follows when inhibitions are released and unconscious difficulties are ventilated.

Persuasion and suggestion

The general principles of psychotherapy apply to children as well as to adults, but special modifications are necessary to meet the particular qualities of the child mind and the child's accessibility. Persuasion and suggestion can prove very efficacious in many minor neuroses. Success with these techniques, however, can only come when a good rapport is established between the child and the practitioner. Ultimately the same psychological conditions favourable to the success of suggestion hold with children as with adults; but with children, when suspicion and fear are aroused, benevolence on the part of the practitioner and a cheerful goodwill are essential. The practitioner must have the capacity for simple explanations, but the *sine qua non* is the adoption of a good parental attitude; for, inasmuch as so many neuroses have been produced in the child mind by the construction of bad or terrifying parent images, the creation by the practitioner out of himself of a good and tolerant parent figure will be a measure of his therapeutic success.

Psychoanalysis

For cases in which the mental mechanisms involved render suggestion and persuasion of little direct value, modified psychoanalytic techniques

Analysis of play

have been developed. The outstanding technique for children is the analysis of play, for it is through play that the child exhibits his imaginative activities and tends to dramatize his emotional problems. Only those who are skilled in understanding the play language of children should attempt this delicate interpretative therapy. The treatment of incipient psychosis also entails psychoanalytic understanding, if not the practice of the psychoanalytic method. Many psychiatrists dispute the value of psychoanalysis for this group of conditions. The general consensus of opinion is probably in the direction of treating such children by radical changes of the environment based upon special psychological considerations. In some cases, whether neurotic or psychotic, not only must the child be treated, but the parents should be subjected to a careful psychiatric scrutiny, for sometimes they are just as much in need of mental readjustment.

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PSYCHOANALYSIS

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Reference may also be made to the following titles:

ALCOHOLISM
DRUG ADDICTION
EXHIBITIONISM
IMPOTENCE
PSYCHIATRY OF CHILDREN
PSYCHONEUROSES AND PSYCHOTHERAPY
PSYCHOPATHIC PERSONALITY
PSYCHOSES
SEXUAL BEHAVIOUR AND ABNORMALITIES

1.–DEFINITION

1314.] Some twenty years ago psychoanalysis might have been defined as a form of mental treatment applied mainly to the psychoneuroses, but since then the term has acquired wider significance. The psychoanalytical method is now applied to practically any abnormal mental function. In addition it is now recognized as one of the most penetrating methods of mental investigation and research, and a considerable amount of attention has been devoted to the minds of so-called normal persons, both adults and children. As a result, much more is known about the structure of mind, its developmental layers or stages, the primitive instincts that supply it with energy, and the mental mechanisms that regulate these energies. The results obtained in all fields of investigation have been collected and constitute a theory of mental function. In so far as mental function is abnormal, this theory has provided the basis of a working aetiological system. Psychoanalysis is thus a method of mental treatment, a technique of mental investigation, and a theory of mental function.

2.–THEORETICAL CONSIDERATIONS

Psychoanalytic theory is distinguished from other psychological hypotheses by its concern with deep unconscious layers, activities, and functions; psychoanalysts are therefore not satisfied with a purely clinical description of mental events or symptoms. These can be understood only if stated in a number of different ways, the most important of which are (i) dynamic, (ii) structural or topographic, and (iii) economic.

Dynamic concepts

Psychoanalysis emphasizes the fact that behaviour is motivated primarily by instinctual urges within the individual. This emphasis on a central hypothesis of mind was necessitated by the discovery that there exist at the core of the mind primitive instinct energies of which there is little or no evidence on the (conscious) surface. The greater part of this deep energy is potential, but activated quantities can be detected in dream-life, in psychoneurotic and psychotic symptoms, and during the more important crises of sexual and social life. The struggle of the mind to control these deep energies and the concessions unwittingly made by the ego to relieve their tensions are responsible for the great majority of psychopathological symptoms.

Primary instincts

The primary instincts with which the psychoanalyst is most concerned are the love-instincts (sexual instincts in the broadest sense) and a large group of drives labelled roughly instincts of aggression, destruction, and mastery. Either individually or in combination these two groups cause most forms of mental disorder. Primary drives of unconscious sexuality and aggression are seldom seen in pure form. Roughly speaking, however, in most psychoneuroses, particularly the anxiety states and conversion hysterias, the mental conflict giving rise to the symptoms is due for the most part to unconscious sexual impulses of an infantile type. In the psychoses and any other condition in which unconscious guilt is conspicuous, some pathological disturbance of unconscious (infantile) aggressive impulses may be regarded as the main factor.

Phases of infantile sexuality

Most forms of infantile love and hate can be classified in accordance with phases of development and the main body-zones concerned. Thus during the first five years of life infantile sexuality passes through oral, excretory, and genital phases and is expressed through a number of component impulses, mostly but not exclusively connected with body-zones of libidinal interest: oral, gastric, respiratory, anal, urethral, genital, cutaneous, or muscular. The operation of these components can be observed in a more or less pure form in certain sexual perversions of adults: oral, anal, and genital perversions, sadism, and masochism. The zonal nature of infantile sexual excitation is an important factor in the localization of hysterical conversion symptoms.

Aggressive instincts

Similarly, infantile destructive and aggressive impulses can be subdivided into phases corresponding to those of infantile sexuality, e.g. oral sadism, muscular sadism, excretory sadism, and genital sadism. In consequence, when conflicts are aroused by hate-tensions their symptomatic expression varies; genital sadism usually gives rise to hysterical symptoms; in obsessional psychoneuroses and some forms of drug addiction the conflict is caused mainly by excretory sadism; in melancholia by oral sadism. In schizophrenia every possible type of unconscious sadism can be activated. It is sometimes possible to trace a direct relation between the clinical picture and the particular instinct causing conflict, e.g. refusal of food by melancholics whose oral sadism is causing conflict.

Affective states

Frustration

Anxiety

Guilt

The dynamic power of instincts is due in the main to the affects (emotional tensions) they produce or are associated with. These are of four main types: gratification affects, frustration affects, anxiety, and guilt. Psychoanalysis pays most attention to the last three. Frustration, in particular unconscious frustration, causes anxiety, which in turn arouses hostility against the objects associated with the frustration. Hostility that is unendurable by the infantile ego is usually absorbed within the self. This absorption increases the ego's tendency to anxiety. Anxiety can be aroused by tension of any instinct; guilt is more closely associated with difficulty over aggressive instincts. In course of development affects become more complicated. They fuse with one another, e.g. anger, grief, and remorse can fuse in a common depression. Hence it is difficult to trace unmodified primary affects in different psychopathological states.

Economic aspects: mental mechanisms

Projection

Each phase of infantile development has characteristic mental mechanisms. Thus projection mechanisms, i.e. the attribution to an external object of impulses or feelings existing in the individual's unconscious mind, dominate the first two years. They are seen in pathological form, e.g. delusions or illusions of external danger, in schizophrenia, paranoia, and paranoid dementias, but also play a part in drug addiction and to some extent in the formation of phobias. *Introjection* Introjection, the companion mechanism to projection, involves the usually permanent modification of ego structure as a result of contact with the early external objects of instincts—in the first instance parental organs gratifying or frustrating the infant, later the parents themselves. As a result of these strong impressions part of the infant ego becomes as it were a 'parental department' of the mind and operates 'as if' the parents themselves existed in the child's mind. Pathological effects of early introjections are seen in the disintegration products and depressive reactions of schizophrenia and on a more organized scale in the depressions, e.g. delusions of being possessed by evil spirits or of inner worthlessness. Introjections merge *Identification* gradually into forms of identification but have less elasticity and less contact with reality. Identifications are more concerned with the total imago of important family figures, e.g. parents, but they do not merge with the ego in the same way as introjections and can more easily be abandoned. Pathological identifications bulk in the clinical pictures of obsessional psychoneurosis and hysteria, e.g. in unconscious mimicry *Repression* of a parent's illness. Repression is a mechanism for withdrawing energy from unconscious constellations or complexes, as a result of which neither the ideas in question nor their associated affects appear or are experienced in consciousness. Faulty repression plays an all-important part in every form of hysteria. Unconscious mechanisms are not in themselves pathogenic, merely the faulty (inadequate or excessive) function of these mechanisms. An unconscious mechanism contributing to most mental activities and therefore to most psycho- *Displacement* pathological manifestations is displacement, including substitution and *Substitution* sublimation. In substitution the place of the original objects of the instinct is taken by others which do not cause conflict, e.g. external *Sublimation* figures of authority for parents. In sublimation, which is concerned with quantities of frustrated infantile sexual instinct, not only is there substitution of object but an asexual aim replaces the primary sexual aim of the instinct; hence sublimation is an important factor in maintaining mental balance, and its manifestations are rarely pathological. Pathological displacement is seen in all mental disorders, especially in the hysterias and obsessions, e.g. chronic nausea as a displacement of unconscious genital repudiation. Break-down of sublimation is a predisposing factor in illness; hence every anamnesis should include a survey of work, habits, hobbies, and recreations, both social and individual.

Mental structure The most important fact about mental structure is that, apart from the numerous patterns of behaviour and thought that are open to inspection or introspection, a large part of the ego is unconscious, one of its chief functions being to set unconscious defence mechanisms in operation. Only when these unconscious mechanisms are unsuccessful can evidence of the existence of the unconscious ego be experienced or detected on the surface. This varies from conscious feeling of guilt or inferiority to major dissociations and depersonalizations, from day-dream to delusion. Even if the surface of the ego is undisturbed, its deeper structure is usually in a state of active cleavage. It is divided naturally into a scrutinizing or censoring part, called the super-ego, and a scrutinized part. The affective state accompanying deep splitting is called unconscious guilt, the manifestations of which vary with the phase of development. The clinical picture of hysteria shows a tendency to isolate or dissociate the symptom from the rest of the ego, the dissociation being stimulated by infantile genital sexuality. In obsessional psychoneurosis conflict between ego and super-ego is due to earlier, less localized, and more aggressive forms of love-interest, i.e. to anal-sadistic impulse. The obsessional psychoneurosis is essentially a guilt psychoneurosis. In manic-depressive conditions the state of cleavage is very profound and is manifested on the surface as an alternation of states, the depressive phase of which is essentially a guilt psychosis. The multiple splittings of schizophrenia suggest that in the earliest phases of development the unconscious ego is not divided into two opposing parts, but that a number of ego nuclei are laid down in the earliest stages of infancy.

Super-ego

Unconscious guilt

Symptoms are attempts to adapt to stresses of instinct which, however, are not experienced as such in consciousness; hence the cause of the stress (frustration) may not be obvious. When an obvious cause is present, this precipitating factor is invariably instinctual and of emotional significance, e.g. onset of puberty, marriage, climacteric, death of relations, changes of occupation, and loss of money. In some cases the apparent precipitating factor, e.g. squandering money, is really spurious or has been induced by the patient to provide occasion and excuse for a psychoneurotic break-down. In many cases, particularly in the psychoses, no precipitating factor can be determined. Attempts to combat psychoneuroses by manipulating the precipitating cause, e.g. in the case of sexual inhibition by recommending marriage, are rarely successful, because even when present the precipitating factor is either the first or the last of a long series of events. The anxiety it arouses unconsciously leads to a withdrawal of energy from current life. This sets up an unconscious regression of energy to deeper layers of the mind and activates not only earlier (infantile) impulses but also the earlier mechanisms of child conflict. Repression is unable to control these reinforced energies or to disguise the action of primitive mechanisms, and symptom-formation appears. Symptoms are not only a disguised gratification but also a repudiation of these freshly activated unconscious (infantile) wishes. In so far as the symptoms are painful or a drawback to the ego, they represent punishing tendencies of the unconscious super-ego. Sometimes, particularly in obsessional psychoneurosis, they constitute expiatory acts. Their ideational and emotional content is derived mostly from the infantile period reactivated in regression. The choice of reactivated phase depends on the maximal point of infantile fixation, which in turn

Symptom-formation

Precipitating factor

Regression

Nature of symptoms

Primary and secondary gain

is determined by the original strength of infantile wishes and the amount of conflict they originally produced. Although the main function of the symptom is to deal with unconscious conflict, and although it may appear to have little or no relation to current life, once it is established it usually exercises a direct influence on the immediate environment. The patient unwittingly extracts a good deal of advantage, especially from the immediate family circle. This is called secondary gain, to distinguish it from primary gain, i.e. relief from unconscious conflict.

3.–PRACTICAL APPLICATIONS

Selection of cases for psycho-analysis

Preliminary 'resistances'

Although the range of psychoanalytic treatment has gradually widened until it has come to include practically any form of mental abnormality, discretion must be exercised in recommending cases for psychoanalytic treatment. Even with the most straightforward case of psychoneurosis or psychosexual inhibition it does not follow that the patient will automatically respond favourably to psychoanalysis. He may accept an authoritative recommendation to undertake treatment and yet remain refractory either because his unconscious fears of mental 'interference' are too strong or because the primary and secondary gains derived from his illness are sufficiently great to sap any effective drive to recovery. Even should they commence treatment, such patients may break off within a few weeks on one pretext or another. It is important therefore to estimate the 'preliminary resistances' to psychoanalysis. If these should appear to threaten success, the position should be explained to the patient but no pressure should be brought to bear on him. A brief delay will usually bring the matter to a head. During this delay any form of treatment to which the patient is ready to respond can be recommended or tried. Often patients will turn to psychoanalysis only after they have tried every known form of non-analytic treatment.

Inaccess-bility'

Another problem in selection of cases arises most often with psychotic persons, but also with cases of severe sexual perversion, chronic marital difficulties, or persistent delinquency. For example, in advanced cases of psychosis or during acute phases of early cases it is obvious that the processes of disintegration or dissociation have rendered the patient 'inaccessible' either permanently or for the time being.

If a psychotic patient has already embarked on a downward curve or regression, it is probable that this cycle will be completed. To recommend psychoanalysis at this stage is to court disappointment for some time ahead. Grave character cases though not psychotic in the clinical sense may present just as inaccessible a front. In such cases pressure to undertake analysis should come from the patient's side, and he should not be led to entertain false hopes of cure. On the other hand, many severe cases are by no means so intractable as they look and deserve to be singled out for analytic treatment. Further, cases in which a threatened crisis seems likely to be averted by immediate psychoanalytic treatment repay early diagnosis of the critical phase. Borderline psychotics raise urgent problems of therapeutic policy.

Apart from personal training in psychoanalysis, the best method of acquiring the necessary judgement in these matters is to combine clinical experience with an adequate orientation concerning the particular psychoanalytical character of each group. In the following brief survey some indications of these are given. The review is arranged in order of depth of conflict.

(1)—Psychoses

Classification of psychoses

Psychoanalysts follow the example of psychiatrists in isolating three main group-reactions: schizophrenic, paranoiac, and (manic-) depressive (see the respective subjects, pp. 302, 292, and 267). Whether or not advanced cases will ever respond to analytic technique is an open question. In the meantime early manic-depressives and some mild schizophrenics and paranoiacs respond favourably on occasion; hence nicety of diagnosis is at first less important than early recognition of a positive psychotic trend. Once a provisional diagnosis of psychosis has been made, the degree of contact with reality should be estimated to determine whether the case is suitable for immediate analysis or whether a provisional policy of hospital treatment is indicated. This can often be determined by a careful examination of the strength and organization of prevailing phantasy preoccupations, including any delusional products that may be present. Comparative stability of the ego in the face of current emotional stresses is an indication for psychoanalytic exploration.

(*a*) *Manic-Depressive Psychoses*

Combination of manic and depressive mechanisms

Manic-depressive patients show recurrent cycles of mood and behaviour, passing from depression and inactivity to exaltation with hyperactivity and then to a more normal but rather obsessional phase. Even in typical mania it is possible to find traces of depressive mechanisms. Similarly in melancholia, although exaltation is usually absent, the existence of manic mechanisms is represented in certain cases by agitation.

In fully developed forms of these disorders the reality ego is swamped by phantasies of unconscious origin. The 'misery' of depression is a manifestation of unconscious self-hatred, which is expressed also in feelings of boredom or delusions of worthlessness and may culminate in suicide. The psychomotor retardation of melancholia is in part a protection against delusions of sinfulness. The dangerous sinner immobilizes himself. Hypochondriacal ideas are due to belief in possession by evil spirits. By contrast, the manic patient has a sense of freedom and release, feels well, and may be active to the point of megalomaniac frenzy.

Guilt psychoses

These are true guilt psychoses. The strife between primitive impulse and primitive conscience is more acute than in obsessional psychoneuroses and affects the whole personality. As distinct from paranoia, in which projection mechanisms are exploited, the effects of introjection mechanisms are dominant. The patient has unconsciously identified himself with the infantile parental images he has ceased to love. He lives in a mental prison with them, hates them (thereby hating himself), and at the same time suffers excruciating conscience-anxiety (guilt) for having done irreparable damage to these once-loved objects. One of the functions of mania is to endeavour to cure this depression. The guilt of melancholia is denied in mania, and energy is released in the ego. This is accompanied by projection, a reinforced externalization of interest.

Introjection

Projection

Depressive disturbances are most often associated with an exaggerated oral-sadistic phase of development, but many transitional types suffer from excessive excretory sadism, especially of the urethral type. These conflicts are usually expressed in vivid phantasy systems and also in excessive inhibition of phantasy. A mild cyclothymic temperament is less a certain sign of early manic-depressive states than an excessive and prolonged reaction to frustration or emotional trauma, e.g. neglect or hurt (see also p. 267).

(*b*) *Paranoia*

Projection

The typical symptoms of paranoia, e.g. persecutory, erotomanic, or religious delusions, are created by projection. There is a resemblance between paranoid delusions of persecution and phobias: the earliest phobias of infants up to two years are paranoid in type. Phobias derived from later infancy are psychoneurotic. When they erupt the patient recognizes his anxiety as a symptom, whereas the patient suffering from a delusion is convinced of the truth of his delusion.

Contact with reality

Unlike the schizophrenic, the paranoiac's contact with reality is usually unimpaired, except as regards the delusions, which are usually systematized and localized. They are essentially animistic in type. Unconscious family hatred is one of the most important factors in persecutory formations. The individual feels in danger of external attack to the extent that he repudiates his internal hatred of parental images. Infantile sexual organization is conspicuously anal-sadistic; strong unconscious homosexual fixations exist but are denied in consciousness by the delusional system which states in effect 'I do *not* love him, he *hates* me'. Delusional formations set up reactive defences of two kinds: flight reactions resembling phobias, e.g. refusal of food, and aggressive reactions, e.g. litigious paranoia (see also p. 292).

(*c*) *Schizophrenia*

In schizophrenia the personality shows a remarkable degree of fragmentation; hence the ego is extremely weak and helpless. Loss of contact with reality is excessive and in direct ratio to an incapacity for work, interest, or affection. Great anxiety and need for love may be displayed but are usually accompanied by much negativism. The patient lives in a phantasy-world of his own; this withdrawal into phantasy leads to a more and more infantile disregard of adult standards, which is due not entirely to regression but also to the fact that under the surface the schizophrenic has never attained the same degree of mental integration as has the paranoiac or the depressive.

Although the schizophrenic has obviously had difficulty at every stage of infantile development, the nature of his mannerisms, hallucinations, and deterioration products usually indicates one or two central sources of conflict. Very commonly there is an exaggeration of anal sadistic organization covering a deep oral sadistic regression.

Defence mechanisms

The schizophrenic exercises a wider range of unconscious defence mechanisms than any other psychotic type. But he does so in an apparently more capricious and less systematized way than the depressive or paranoiac. Favoured methods are the immobilization systems of catatonics, the projection systems of paraphrenics, and the introjection mechanisms of depressive types. Although some catatonic types give a more stabilized impression during remission it seems that the types most likely to respond to psychoanalysis are those in which depressive mechanisms are combined with psychosexual systems of a mildly perverted type. The fixation points of the psychoses lie between birth and two to two and a half years of age (see also p. 302).

(2)—Drug Addiction

This borders on the line between psychoneuroses and psychoses and frequently functions as a defence against a psychotic break-down. The slow suicidal effects of addiction may be a substitute for the more powerful suicidal drives of manic-depressive insanity. On the other hand, the amount of projection used by drug addicts suggests a close affinity with paranoid states. On the psychoneurotic side of the picture there is an obvious obsessional (compulsive) element present, whereas the physical consequences of addiction, e.g. loss of weight and appetite, function, according to the strength of the drug, as slow or rapid conversion hysterias. Hence the fixation-points of drug addiction lie between one and a half and three years of age. The attitude to the drug is ambivalent; it is necessary but hateful. The unconscious sexual gratification obtained is usually of the oral sucking type, but there is always a pathogenic quantity of sadism present, both oral and excretory. The importance of unconscious homosexual urges is most obvious in alcoholism in males. Unconscious genital anxieties are accentuated in those addictions involving piqûres. The patient's sadism is projected, focused, and localized on the drug, which is then controlled by internalization. This depends on the animistic view that an evil spirit or object, however damaging to the individual, can be better restrained when taken into the body. This compulsive play with drugs represents unconscious relations with the primitive parental objects of infantile love and hate. The amount of sadism in the primitive system is in direct ratio to the injurious nature of the drug taken.

Abstinence

Although abstinence is easier to induce with some drugs than with others, e.g. with cocaine than with morphine, the practice of inducing rapid abstinences should not be followed without first discovering the unconscious function of the addiction. Addicts who favour frequent self-imposed abstinences have a concealed manic-depressive organization. (See also ALCOHOLISM, Vol. I, p. 287; and DRUG ADDICTION, Vol. IV, p. 259.)

(3)—Sexual Perversions

Function

These share one of the functions of both psychoneurotic and psychotic symptoms, i.e. to defend against unconscious mental conflict. Surprising as it may seem, the conflict is not exclusively sexual in origin. Sexual manifestations are frequently exaggerated in order to conceal underlying anxieties concerning the unconscious aggressive accompaniments of infantile sexuality. Perversions allow a degree of pleasure gratification more or less accepted by the ego, whereas symptom-formations are usually painful to and rejected by the ego. Hence, although many simple perversions, e.g. exhibitionism and viewing, are apparently unmodified infantile sexual remainders, they are not due simply to arrested sexual development; like symptoms, they are regressive. Adult sexuality is sacrificed in favour of one or more infantile components, but the infantile component chosen acts as a screen for more active incest-wishes which have remained in a state of faulty repression. Constitutional factors are important but not decisive. Early phases of excessive excitation of any one infantile component are predisposing. The more primitive the perversion the deeper the unconscious anxiety. Some forms of coprophilia and some sadistic perversions cover anxieties which would otherwise cause psychotic reactions. The homosexual perversions, though varying widely in type and deriving their force from several different developmental layers, are nevertheless the most advanced forms of sexual perversion.

Aetiology

Homosexuality

The two main unconscious situations can be observed (most easily in males): (i) the negative Oedipus situation in which, in males, the love-object represents the father to whom the subject behaves passively, and (ii) the situation in which the love-object is a projection of the self and is loved by the subject as the latter once wished to be loved by his mother. Castration-anxiety is a prominent feature of the unconscious situation, but in all cases this covers a variable amount of fear and guilt aroused by early oral and anal sadistic reactions to the mother. In transvestitism this fear and guilt are singled out and denied by identification. Fetichism, by concentrating the sexual interest on a part of the clothing, e.g. shoes and corsets, is a still more exaggerated denial of early anxieties. The love-object, as such, is eliminated altogether. Masochistic perversions should always be examined for an underlying depressive organization.

Accessibility to analysis

In estimating the accessibility of perversions to psychoanalysis four factors should be taken into account, namely, age, the nature of constitutional factors, the proportion of passive or masochistic aims in the perversion, and the depth of conflict. This last can often be estimated by studying the nature of any minor symptoms that may accompany the perversion. Fixation points vary in direct ratio to the depth of the perversion. (See also SEXUAL BEHAVIOUR AND ABNORMALITIES.)

(4)—Psychoneuroses

(a) *Conversion Hysteria*

Aetiology

The conversion symptom is the commonest and yet the most remarkable of all psychoneurotic constructions. Pathogenic instinct-energies are converted into somatic excitations; by this means the symptom serves as a complete denial of mental conflict. It is simultaneously an unconscious gratification of repressed instinct, a defence against the anxieties of instinct gratification, a punishment, and a principal lever against the patient's family and social environment. It is thus a monophasic psychoneurosis.

Diagnosis

Any anomalous somatic disturbance for which an adequate organic cause cannot be found should be regarded as a possible conversion hysteria. Similarly, any curable organic disease which does not respond to appropriate treatment should be investigated from the point of view of a secondary hysterical fixation. Differential diagnosis is effected by a careful comparison of the evidence in favour of a genuine disturbance of physiological function with the history of psychological conflict.

Localization of symptoms

Conversion hysteria is an attempt to avoid anxiety due to the reactivation of infantile sexual conflict. In most cases the conflict is over infantile genital incest-wishes. This influences the localization of symptoms in three ways: (i) physiological systems or organs that contribute to infantile sexual interest are specially vulnerable, e.g. mouth, anus, and gastro-intestinal system; (ii) systems normally affected by anxiety, e.g. cardiovascular, respiratory, and intestinal, are naturally seized upon; and (iii) parts of the body that form suitable unconscious substitutes (symbols) for genital organs, e.g. head, eyes, hands, and feet, are affected through the mechanism of displacement.

(b) *Anxiety Hysteria*

Claustrophobia and agoraphobia

The cardinal symptom is anxiety, an apprehensiveness with or without the usual somatic expressions of fear, e.g. sickness, palpitation, dizziness, and sweating. Usually the anxiety is attached to one or two specific situations and appears in force only in these situations, e.g. dread of enclosed spaces (claustrophobia) and dread of open spaces (agoraphobia). A careful history will elicit that some phobias have already been present during childhood. The anxiety is connected partly with displacement of inadequately repressed infantile sexual impulses and partly with difficulties over unconscious (infantile) aggression. Part of the fear of the object or situation represents a projection of this aggressiveness on to the external world.

Diagnosis from depression

The depressive features of some anxiety hysterias can usually be distinguished from true depression by the degree of general integration of the personality.

(*c*) *Obsessional Psychoneurosis*

This condition is characterized by a pronounced mental preoccupation (compulsion), which concerns either (i) some stereotyped thought, e.g. ideas of causing injury, or (ii) repetition of some stereotyped action, e.g. hand-washing, or (iii) compulsive alternation of good and bad moods. Compulsive thoughts may develop into elaborate thinking systems, compulsive actions into elaborate and time-consuming rituals. The compulsive ritual is mostly diphasic, one part representing the doing of a guilty (or bad) deed, the other the undoing or expiation. Obsessional neuroses are essentially guilt-neuroses. Failure to carry out compulsive rituals causes acute anxiety mingled with a sense of guilt. The symptoms are derived for the most part from the anal-sadistic phases of development immediately preceding infantile genital (incest) organization. Hence the obsessional organization is extremely ambivalent, i.e. the unconscious attitudes to love-objects are strongly impregnated with infantile hate. The symptom expresses this hate but in an isolated and defended form. It also covers a strong unconscious homosexual organization. Obsessional balancing of emotions causes apathy or more obviously indecision and doubt. Many fatigue symptoms belong to the obsessional rather than the neurasthenic group; in such cases a reinforced conflict over infantile masturbation may be suspected.

(*d*) *Mixed Types*

Classical psychoneuroses are by no means so common as is generally supposed; the cases most often seen in practice are of a mixed type. The commonest combinations are (i) conversion with anxiety hysteria and (ii) anxiety hysteria with obsessional psychoneurosis. There is seldom any difficulty in differential diagnosis. In the combined anxiety and conversion psychoneuroses it is necessary to distinguish any hypochondriacal elements suggesting a degree of psychotic structure. In the anxiety-obsessional psychoneurosis physical accompaniments are not common, but neurasthenic elements may be detected. Anxiety phobias can apparently act as an auxiliary defence to obsessional defences. These are the easiest types to treat. The more chronic obsessional psychoneuroses usually have concealed depressive or paranoid structure, and in some cases the symptoms shade off into depressive or mildly paranoid reactions. Nevertheless as a general rule the existence of an obsessional neurosis is some guarantee against the possibility of a psychotic break-down. The fixation points of the psychoneuroses lie between 2½ and 5 years of age.

(5)—Delinquency and Antisocial Conduct

Systematic attempts have been made to treat delinquencies as a special group of psychic disorders. This group does not include commonplace infractions of civil law; nor, strictly speaking, should it include sexual perversions. The commonest example is that of compulsive pilfering, which is obsessional but differs from the obsessional psychoneurosis in that pilfering involves an attack on an external object. Criminal behaviour can be classified in terms of development fixation in the same way as the psychoneuroses and psychoses. Hence it is important to examine carefully for psychoneurotic or psychotic symptom-formations. Already many delinquency syndromes have been established, e.g. obtaining money by false pretences occurs commonly amongst narcissistic adolescents with a strong latent or unconscious homosexual disposition, who consort with or are sought out by people of a superior social position.

Compulsive pilfering

Psychoanalysis of delinquent behaviour is by no means easy. Even the milder cases that correspond to psychoneuroses require expert handling. In some instances the delinquent symptom is converted during analysis into a typical psychoneurotic symptom, which must then be cleared up before treatment can be regarded as successful. Delinquencies with a psychotic substructure are extremely refractory. (See also p. 203.)

Prognosis of cure

(6)—Marital Difficulties

Many people avoid a psychoneurosis in middle life by making an unhappy marriage. The commonest factor in both sexes is conflict over a strong (unconscious) homosexual fixation. Males have usually shown signs of mild impotence combined with a compulsive drive to sexual activity, which covers a passive feminine disposition. The unconscious attitude to the mother-imago is strongly ambivalent, and the hostility is expressed through marital situations in which the husband incites the wife to attack him. His sexual and to a considerable extent his social technique include a habit of disappointing the woman.

In males

Females have some degree of frigidity, strong unconscious antagonism to the male organs covering an equally strong but hostile identification with the father. The unconscious relation to the mother-imago is charged with hate. The husband after a short period is treated as an inferior possession, subjected to criticism, and neglected in favour of children, who are nevertheless a constant source of anxiety. There are a great number of such difficulties varying in depth, severity, and fixation-point. Marital difficulties and sexual inhibitions have a complementary relation. They are as a rule difficult to treat because of the patient's strong compulsion to repeat emotional crises.

In females

(7)—Sexual Inhibitions

Mild impotence in the male, e.g. ejaculatio praecox and difficulty in erection and penetration, and some degree of frigidity or dyspareunia in the female are among the commonest forms of psychological disturbance. Their significance varies; many of these cases have the same protective functions as mild hysterics but without the expenditure of energy necessary for symptom-formation. In mild cases the unconscious anxieties are of the genital type, i.e. fear of castration in the male and conviction of castration and fear of penetration in the female. The underlying disposition in both sexes is mildly homosexual, and unconscious love-drives are overcharged with sadistic components of urethral or anal origin. As a rule these cases are readily amenable to psychoanalysis. Deep, prolonged, or intractable sexual inhibition is of more serious nature; it corresponds either to a deep obsessional defence, the inhibition being a measure of the unconscious compulsion, or it represents part of a depressive system, a localized denial of body-function. In schizoid types sexual inhibition is selective and may alternate with outbursts of compulsive (perverse) sexuality. (See also Vol. VII, p. 105.)

(8)—Social Inhibitions

Like sexual inhibitions, social difficulties vary in form and depth. Many of them are simply mild anxiety states, such as excessive shyness and fear of blushing; others are due to the interference of obsessional or depressive reactions, e.g. inferiority giving rise to inertia and lack of concentration. Inhibitions in learning and of play are usually substitutes for inhibitions of infantile sexual curiosity or of unconscious aggression. The specific components causing the difficulty can frequently be surmised either from the localization of the inhibition, e.g. pianist's cramp due to unconscious conflict over infantile masturbation, or from the symbolism of the activity inhibited, e.g. shooting, motoring, and diving, unconsciously equated with coitus. In inhibitions of work there is usually a strong masochistic and self-punishing element. Generally speaking, the more wide-spread the system of inhibitions the more serious the prognosis. Differential diagnosis can be made by reference to the general type of mental organization together with any psychoneurotic or psychotic traits that may be present.

(9)—Psychoanalysis of Children

Roughly speaking, the mental disorders of children are just as closely subdivided as those occurring in adults. Difficulties in diagnosis are due to the fact that many manifestations that would be regarded as abnormal, even psychotic, in adults are not specially abnormal for children, e.g. infantile types of paranoid fear. Indeed many symptoms, e.g. disturbances in eating, are not regarded as psychopathic at all, although some forms of eating or of intestinal upset are among the earliest signs of infantile psychoneurosis or psychosis.

Phobias

Next in importance come various forms of phobia, e.g. fear of the dark and of noise. The earliest phobias, from birth to two years, are animistic, e.g. fear of inanimate objects and animals, and usually accompanied by other signs of anxiety, e.g. night-terrors. Phobias in children aged four or five years are usually hysterical. Between these early and late phases of anxiety the child exhibits an obsessional phase, which can be expressed in various compulsive habits, e.g. bed-wetting; or habit spasms, e.g. tic; or rituals, e.g. interminable stereotyped play. A good deal of overt sexual activity occurring about two to three years

Obsessions

of age is also compulsive and resembles the sexual perversions of adults. Inhibitions are common. Early inhibitions affect eating, walking, and talking. Late inhibitions of play or of the intellectual faculties or of emotional expression often follow a compulsive phase of sexual activity or a period of violent social reaction, e.g. tantrums. Normal inhibitions are most prominent after the age of four to five years. On the other hand, antisocial characteristics, e.g. compulsive lying, stealing, and acts of violence and destruction, may break out for the first time after that age. In the average child early disturbances usually disappear spontaneously during the latency period, i.e. five to ten years. Infantile symptoms persisting after the age of five are certainly morbid. At this stage a final diagnosis should be easily reached. Before five diagnosis is more difficult but repays any effort that may be necessary, since the earlier analysis is begun the better are the prospects of ultimate success.

Inhibitions

(10)—Diagnosis

It is difficult to combine psychoanalytic practice with the exacting and irregular routine of general practice. Psychoanalytic orientation and understanding, however, are invaluable for the early diagnosis and prophylaxis of mental break-down. Successful prophylaxis depends mostly on the recognition of abnormalities in infancy and childhood before they come to the stage of break-down. Otherwise the first concern is accurate diagnosis.

Classification of cases

There are roughly three groups to be considered: (i) the milder psychoneuroses and those milder perversions and social and sexual inhibitions which belong to the same aetiological level; (ii) the deeper psychoneuroses, e.g. depressive hysterias and slightly paranoid obsessions, and perversions together with transitional conditions of the drug-addiction type; and (iii) early forms of true psychosis, severe alcoholism, and grave social and sexual inhibitions. Cases belonging to the second and third groups should be regarded as urgent and sent for immediate psychoanalytic investigation and, if possible, treatment.

(11)—Prognosis

The accessibility of any given patient to psychoanalysis can be roughly estimated in terms of the groups given above. The prospects of cure in the first or 'mild' group are good. Caution should be exercised in the following instances. Monosymptomatic neuroses are by no means so easy to deal with as they appear. A conservative estimate of the time necessary should be given. Fixation hysterias with a prolonged history of true organic disturbance are not easy. Hysterical phobias covering a psychotic constitution may appear to resolve readily but prolonged and difficult analysis of the underlying structure is necessary before permanent results can be obtained. Apparently mild cases of sexual inhibition or perversion occurring in passive types are very intractable. In the second group (more advanced types) prognosis is not so easy to determine. Chronic obsessional cases in middle age are usually extremely

Mild cases

More advanced types

slow. Subacute types often respond surprisingly early but need a prolonged terminal phase. Generally speaking 'active' symptoms and (or) symptoms that gradually change their form are more promising but this does not apply to sudden changes or acute exacerbation. With regard to the third group (selected psychotic types), appearances are often deceiving. Many apparently promising types, e.g. with mild symptoms of depression or schizophrenia, are about to enter into an intractable phase, whereas some apparently acute psychotic syndromes either subside spontaneously within a short time or respond quite soon to an analytic approach. Nevertheless the general prognosis of this group is not good. Prolonged treatment resulting in sufficient stabilization to preserve a mild degree of working capacity is in many instances justly regarded as a remarkable achievement.

Selected psychotic types

Considering psychoanalytical prognosis as a whole it is generally agreed that except in fairly straightforward cases belonging to the simpler groups only a general probability should be stated on the strength of consultation alone. Once the necessity or desirability for analytic treatment has been determined it is safer in doubtful cases to leave the question of prognosis open until the first phase of analysis has been passed through (within a few weeks to a few months). Some analysts in special cases recommend a 'trial trip' or probationary period but this is not a common practice.

(12)—Treatment

Psycho-therapeutic procedures

It is impossible to describe in a few paragraphs either the rationale of psychoanalytic treatment or the elaborate techniques that are necessary for its successful application. Only a few generalizations can be given here. In principle all psychotherapeutic procedures can be divided into two main groups: (i) the radical psychoanalysis of causes whether deep or superficial and (ii) the (witting or unwitting) exploitation of rapport between physician and patient in order to modify or remove the symptoms. Hypnotism and suggestion are the purest examples of the second group but many therapists endeavour to combine these 'rapport' techniques with some degree of intellectual or emotional analysis directed at the patient's psychological or symptomatic history. These combinations should be distinguished from psychoanalysis proper.

The aim of psychoanalysis is to provide a psychic situation in which the various factors promoting symptom-formation (e.g. immediate causes of regression, infantile fixations, traumas and frustrations, and faulty unconscious mechanisms) can be brought to the surface and ventilated adequately. The process of ventilation is set going by means of a system of 'free association'. The patient is instructed to set aside everyday systems of controlling thought and feeling and asked to let them rise to the surface. In so doing he may uncover unconscious 'pain-causing' (pathogenic) material or at least give the analyst some indication of where painful material lies. In the latter event the task of the analyst is to 'interpret' not only the unconscious material in question

Free association

but the particular defences (one might speak of 'inflammatory' reactions) it has set up. These reactions are called resistances. A specially valuable form of interpretation is that applied to the patient's dreams and phantasy products.

Transference

The most important factor in analysis depends on the action of the unconscious mechanism of displacement. The patient tends to reactivate infantile conflicts and to displace them to the analytic situation in the form of positive (friendly) or negative (hostile) transferences to the analyst. This leads gradually to a transfer or repetition of the whole neurotic situation within the psychic confines of the analysis. The development of this 'transference neurosis' is one of the first steps towards symptom-resolution but the 'neurosis' must be liquidated by appropriate interpretation and working through before permanent results can be obtained. (See also p. 250.)

Psychological assistance by general practitioner

Although it is rarely possible to combine psychoanalysis with general practice, the physician can be of considerable psychological assistance not only to neurotic patients but to organic cases in whom the exacerbating effect of mental conflict is suspected. Many transitory neurotic outbreaks can be tided over by a sympathetic investigation of the emotional situation precipitating the crisis. The analysis of precipitating factors is not a psychoanalysis and in any case should not be attempted without proper orientation on the part of the physician and should not be persisted in if the immediate results are negative or if the condition exacerbates. Even if no deliberate attempt is made to improve symptoms by suggestion, persuasion, or analysis of the precipitating factors, the physician can exert a favourable influence over some of the milder types of disorder merely by establishing sympathetic contact with the patient's psychological conditions (e.g. worries—domestic, occupational, or social, and ambitions). In short he should make a careful survey of all psychological factors, both individual and environmental and past and present. Disapproving or coercive attitudes should be avoided, and the patient should be encouraged to ventilate anxieties and all possible sources of emotional stress. Failing improvement, the patient should be recommended for systematic treatment.

Explanation of psychoanalysis to patient

Assuming that the practitioner has decided to recommend psychoanalysis to the patient his first problem will be how to answer the very natural question 'What is psychoanalysis?' This will give him almost as much difficulty as the psychoanalyst has in giving a brief exposition of analytical technique. The best plan is to explain in as simple terms as possible the nature of unconscious mental conflict and the fact that symptoms, whether expressed by disturbances of thought, feeling, action, or body function, constitute a distorted 'language' giving outlet to the conflict but in a disguised, unsuitable, and self-injuring way. A short illustrative example is often more effective than laborious efforts at exposition. Since most people are either consciously or unconsciously 'nervous of' (afraid of) mental interference or injury, any apprehensions that psychoanalysis will injure or diminish their mental capacities should be allayed. The exact nature of the technique cannot be very successfully conveyed except to persons who are already oriented to the subject but the nature and effect of 'free association' can be described.

Duration of treatment

This naturally raises the very practical question of the length of time necessary for analysis. The best guiding rules here are: to give very conservative estimates and certainly not to attempt to reassure the patient by giving over-sanguine estimates. The length of time necessary depends to some extent on the age of the patient, the clinical type of disease, and the severity of its manifestations but there is no certain ratio between these factors and the length of treatment. Apparently severe outbreaks sometimes readjust rapidly, and a monosymptomatic neurosis (an isolated phobia) may involve a prolonged exploration of the very wide stretch of unconscious organization on which it may be based. In all cases of doubt it should be pointed out that no safe estimate can be given until actual analytic investigation has commenced.

As regards the more general type of case the following rough indications can be given. In the average case of anxiety hysteria (e.g. phobias) rapid symptomatic improvement can be observed within the first six months, followed by a slower and more difficult phase in which improvement alternates with regression. The reverse order can also be detected: namely, a difficult opening phase followed by slow improvement which reaches its climax towards the concluding stages. Even if symptomatic improvement is achieved, this does not determine the length of the analysis, which must be thorough enough to prevent relapse. Hence, even in apparently simple phobias, it is well to warn the patient that his difficulties may take at least two years to analyse. Obsessional cases are difficult and usually lengthy. On rare occasions a complicated obsessional system will clear up superficially in a few months. Nevertheless in all cases the analysis of an obsessional case should not last less than two and a half years and may have to be continued for four or five years. Mild sexual inhibitions often clear up within the first six months. The same cannot be said of mild perversions. In both instances a conservative estimate of two years should be given. Generally speaking estimates of duration should be based on the physician's impression of the total function of the patient's mind, the strength of his instincts, the stability of his ego, and the strength or weakness of his mental defence mechanisms—not on the apparent strength of his symptom constructions.

Cost of treatment

As the problem of duration is complicated by that of expense, some other practical matters should be made clear to the patient. Analysis involves attendance at the analyst's consulting room for a minimum of five sessions a week. The 'analytic' year should, whenever possible, be not less than forty working weeks, usually forty-two. Fees are paid weekly or monthly. The best way to deal with the difficulty of duration is to arrange for analysis at amounts which the patient can afford to pay without feeling undue strain. For this reason he should be asked to calculate what annual sum he could afford to pay, preferably from income, for his treatment. The fact that treatment may need to be limited for financial or social reasons (e.g. work and residence) sometimes provides an unconscious as well as a conscious incentive to respond quickly. But this is not true of more severe or intractable cases.

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PSYCHONEUROSES AND PSYCHOTHERAPY

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Reference may also be made to the following titles:

PSYCHIATRY OF CHILDREN
PSYCHOANALYSIS
PSYCHOPATHIC PERSONALITY
SEXUAL BEHAVIOUR AND ABNORMALITIES

1.–PSYCHONEUROSES

(1)—Definition

1315.] Psychoneuroses are conditions exhibiting either mental or bodily signs and symptoms or both, which are the result of mental conflict and susceptible of cure by psychological means, the patient retaining the same view of the real world as the ordinary person. This is unlike the condition in what are commonly designated the psychoses, in which the world is viewed in the light of delusional or hallucinatory experience, or of disorder of thought, or of profound disturbances of feeling.

(2)—Aetiology

Inheritance

There is a strong impression that there is a hereditary predisposition to such conditions; precise evidence on this point is lacking, but psychoneurotic trends seem more prone to appear in stocks of which many members are unstable in some way; for example, the families in which psychoneurotic anxiety states seem particularly prevalent. It is difficult to separate the influence of heredity from that of parental example, e.g. in the case of a tendency to anxious reactions. (See also MENTAL DISEASE, HEREDITY, Vol. VIII, p. 560.)

Relation of personality to types of psychoneuroses

More definite data are available about the type of personality in which psychoneurotic reactions arise, or at least there is evidence that certain types of symptom are more apt to arise in certain types of personality. The latter can be described as related to the various symptomatic types of psychoneuroses or as showing lesser manifestations of the tendencies which ultimately lead to a psychoneurotic disablement.

Anxious type

The anxious type of personality crosses its bridges half-way; it always insures against the worst by fearing vividly that it may happen and has high aims with a mixture of assurance and depreciation of its own capacity to attain them. Very often the attitude to authority is one of submissiveness; there is a strong need for approval and often a considerable feeling of unworthiness. In thirty-seven patients with anxiety psychoneuroses the most common traits before the onset of the illness were: concentration on work to the almost complete exclusion of definite recreations, yet often with actual dislike of the particular job; sexual difficulties; emotional instability with a strong bearing to the depressive side, with a pessimistic attitude, a general tendency to worry, and some specific fears; a capacity for affection of the dependent rather than of the protective type; a predominating feeling of inferiority and a lack of confidence and initiative, yet with considerable ambition and sensitiveness; and shyness and reserve, with lack of inclination or of ability for social intercourse. These characteristics, if a number of them exist together, might be regarded as factors favouring the onset of a disabling psychoneurotic anxiety state.

Hysterical type

The hysterical type of personality is not the only type in which hysterical symptoms can occur, and 'hysteria' and 'hysterical personality' are by no means the same; they may be very different. An hysterical symptom may develop in almost anyone from some comparatively localized cause within the psyche. On the other hand an hysterical personality is distinguished usually by her strong dramatic sense; she wishes to occupy the centre of the stage; she is immature, gives an impression of childishness and is very dependent on others in a way that exhausts those to whom the patient pins her affection. The closest relation to the opposite sex that such a person can achieve resembles that of a girl to her father and sexually the patient is typically frigid. Such personalities are not exclusively of the female sex.

Obsessional type

The obsessional type of personality is over-conscientious in various ways. The patient is often meticulous, orderly and over-neat in dress, over-correct in small things and, in a certain sub-type at least, obstinate and rigid in his views.

These personality traits are often of the same order and have the same psychological structure as psychoneurotic symptoms. The patient complains only when the characteristics reach a degree of development that is seriously disturbing. Nevertheless it is usually possible to point to a more or less definite time of appearance of the symptoms, which means either that they are new formations or that they indicate a sudden 'rupture of compensation' in arrangements that have previously manifested themselves in character traits which are recognizably morbid, i.e. making for difficulties in adaptation.

Traumatic rigin

Psychoneuroses are often reactions to external situations that the patient dislikes. The simplest is the occurrence of a psychological trauma when the patient is confronted suddenly with something that he does not understand or fears intensely: for example, a situation that threatens life, e.g. war service, or arouses some vital problem, e.g. the sight of someone dying, seen for the first time, or a sudden encounter with adult sexuality without previous education. But such experiences do not produce symptoms in most people; it is as though those who succumb had been previously sensitized, e.g. by dim speculation on ill-understood subjects, as in the case of sex, or by the possession of an egotistical ('narcissistic') character, as in the case of threats to self-preservation, either direct, as in war, or as reminders, e.g. the spectacle of men dying. Traumatic psychoneuroses, however, in this sense are comparatively rare.

ther nvironmental auses

The situations responsible for the production of psychoneurotic reactions, so far as these are reactions to situations, are commonly more everyday and yet in some ways more subtle than this: unhappy conditions of employment or an attitude that makes for unhappiness in regard to occupation; difficult marital situations; uneasy relations with parents; and grossly unpleasant situations involving personal prestige, ranging from fear of detection for a theft to the acknowledgement that one has been beaten by a better man—all these and their numerous variants may precipitate a psychoneurosis. But even in the most obviously difficult position more than the external situation is concerned; there must be a predisposing factor in the personality of the patient, especially the various forms of egotism, vanity, lack of courage, want of confidence (inferiority feelings), and morbid conscientiousness and the like. Furthermore, the situation itself, e.g. an unhappy marriage, may have been produced by the patient's morbid traits of personality.

Causes in early childhood

The more subtle causes of psychoneurotic illness depend on miscarriages of psychological development. These may occur at a very early age and may remain comparatively isolated from the main stream of experience and yet be capable of interfering with important adaptations in later life, as for example when a boy's excessive attachment to his mother in his childhood leads to an anxiety psychoneurosis when confronted with the prospect of his marriage. Sometimes such psychological mishaps in early life show themselves later in the form of anxiety symptoms even in the absence of any observable precipitating situations: for example, an individual may begin to have a phobia of closed spaces without a demonstrable precipitating cause. No doubt sometimes the outcropping of the symptoms is not so spontaneous as it seems; the very condition that some day makes the outcropping of the symptoms possible begins by producing dissatisfaction with real life.

(3)—Psychopathology

It has already been mentioned that faulty traits of personality—i.e. symptoms so habitual as to become part of the individual and leading to dissatisfaction and distress, may culminate in fully developed psychoneurosis. It is not difficult to see, for example, that a habitually fearful attitude to life, induced in the first place by the example of an over-anxious parent, may develop into a too ready anxiety in the face of life's difficulties; or a habit of evading difficulty by lying and self-deception, including the development of some 'pain' when the individual is confronted with any distasteful task, may end in the development of, for example, paralysis of a limb, whenever this may be convenient.

Reactions to traumatic experiences

Factors threatening self-preservation

The psychopathology of truly psychological traumatic experiences is not so simply understood. They may be divided into (i) those involving the instincts of self-preservation directly or indirectly, and (ii) those involving erotic interest. Factors threatening self-preservation may be either direct, which threaten life, e.g. a shell-burst in war or an earthquake, or indirect, which remind the individual of extreme danger to self-preservation, as when death is witnessed.

'Fright neurosis'

The direct result of the first is what has been called a 'fright neurosis', the word fright expressing the immediate mental experience; the symptoms are those of paralysing fear, but they gradually die out spontaneously provided that no other element enters, e.g. motive to escape from any chance of repetition of the experience. The whole process in a 'fright neurosis' occurs at an elementary level of complication—the individual perceives danger and so develops the bodily reverberations of fear (e.g. palpitation) consequent upon this perception. For a time a mental preoccupation with the original experience persists, as if the individual had not been able to assimilate it. The terrifying war dreams of soldiers, who had been subjected to scenes of carnage, are an example of this. The only ultimately persisting effects are a 'sensitiveness' towards any similar experience and a tendency for the same feelings and bodily disturbance to be re-aroused by any associative reminder, in a way analogous to a conditioned reflex.

A similar persisting emotional effect is seen for any important emotional experience in ordinary life, when social existence has been at stake: for example, when an innocent person has been tried for some crime and acquitted, the ordeal may make such a mental impression that the sight of a policeman afterwards may re-awaken in some degree the unpleasant feelings and bodily sensations which occurred at the time he was charged.

The most severe 'fright neuroses' are seen after totally unexpected events, such as earthquakes. In war there is commonly a long period of anxious expectation which considerably enhances the fright and makes after-effects more probable. The expectation has commonly involved a mental conflict between the instincts of self-preservation and ideals of duty; the traumatic experience impinging on a mind already the seat of conflict releases the signs and symptoms of fright proper. Symptoms are far more persistent in such a case, since they give scope for the existence of the self-preservative aim, offering as they do an escape from responsibility into illness. When this occurs, the fright or traumatic neurosis is succeeded by a full-blown anxiety psychoneurosis or hysteria.

Shell-shock

Most shell-shock cases of war-time and many apparently traumatic psychoneuroses of peace are not truly traumatic, since the direct emotional effect of the traumatic experience is of minor importance; the predisposing sensitizing conflict is the most important factor. Similarly insurance companies paying compensation for 'shock' in accidents are sometimes really paying for the results, say, of a broken heart, as, for example, when a motor accident has been the last straw to some love-lorn girl.

Factors involving erotic interest

The other class of experience which can be immediately traumatic, in the sense of acting as a psychological trauma, is the sexual group—in the form of some direct presentation of sexual facts with which the individual has been inadequately or not at all acquainted—e.g. an episode of exhibitionism at the hands of some older person, an indecent assault, or, in children, witnessing adult sexual activity. The last was formerly a favourite theme of Freudian psychoanalysts—the so-called 'primal scene' witnessed by the child while sleeping in the parents' bedroom and regarded with a mixture of wonder and fear.

'Primal scene'

The experience of exhibitionism or assault certainly produces great uneasiness of mind, sometimes with consequent signs of anxiety, physical and mental; but it is surprising that it does not do so oftener. Probably the explanation lies not in pre-existing complete ignorance of sexual facts, since in that case the episode would have no meaning and would arouse only curiosity or, in the case of assault, the fear that may be the result of any physical violence. The trauma probably produces symptoms only in someone who has already ruminated on these topics without understanding them and with consequent pre-existing uneasiness, or if it starts a train of rumination in which curiosity collides with fear of adult disapproval. The primal scene was formerly supposed by Freudians to be a *sine qua non* for the development of any hysteria, but this view is no longer held. A primal scene is certainly not discernible in many cases, but when it does take place it produces in some young children a profound effect, both in the form of symptoms representing in symbolic form the child's rumination over what it may conceive as an assault by one parent on the other, and, much later, in a disturbance in the child's attitude towards its own sexual life, the effect being sometimes to produce antipathy or indifference to anything sexual and sometimes to favour the development of such emotional attitudes as are implied in the term 'Oedipus complex'. Experience also shows that with or without 'scenes', sexual rumination can begin in very young children, in whom curiosity about the mother's and father's body can be seen struggling with something akin to conscience. *Oedipus complex*

Reactions to difficult situations

The psychopathology of psychoneurotic conditions which are reactions to situations which are, or are conceived to be, difficult can be comparatively simple. In the most elementary terms, there is a mental conflict—an opposition of two personal tendencies, e.g. inclination and duty; desire and conscience; pride or vanity and a distasteful situation, e.g. the acceptance of a business position of lesser importance; or between hatred and necessity dictated by self-preservation. In all such instances a general mental uneasiness is set up, which is best designated 'anxiety'. Anxiety is that state of mental tension which ensues when two strongly emotionally-tinged trains of thought co-exist and are not in harmony with one another. The physiological analogy is with a conflict of impulses for the final common path or, a closer analogy, Pavlov's experiment in which a dog has to make a choice of reaction to two closely similar stimuli. This uneasiness reverberates throughout the nervous system into both the voluntary muscles and the viscera, so that the patient becomes tense and tremulous, complaining of headaches (pain in the head, vertical pressure, band round head), palpitation, dyspepsia, and the like. *Anxiety*

He complains of these symptoms without mentioning his personal difficulties until the doctor inquires for them, and very often not even then until inquiry is made in a special way. He is unaware or 'unconscious' of the connexion between his mental conflict and his symptoms; his anxious preoccupation readily transfers itself from his problem to his symptoms, and he concludes that he is a sick rather than an unhappy man.

This unawareness can be due to one of three causes: (i) simple ignorance, (ii) refusal to recognize the connexion between conflict and symptoms, and (iii) refusal to acknowledge that there is a conflict, e.g. that his pride has been hurt or that he is evading a difficulty.

Repression

The young man who presents himself with symptoms of fatigue, insomnia, and recent inability to pass examinations, who is found to be shirking the breaking off of an engagement which he has ceased to want and who pretends to himself that the proposed break is for the sake of his fiancée, is an example of (iii). This is one of the simple types of repression which certainly occur unconsciously, in the sense that the patient does not admit to himself that he is evading a responsibility.

Shell-shock

Such a situation—conflict producing symptoms—may illustrate another principle of psychopathology, namely, the possibility of escape from a difficulty, for a time at least, through symptoms. The classical example is the 'shell-shock' or war neurosis. This is sometimes called the gain through illness or the unconscious purpose of the psychoneurosis.

Importance of experiences in childhood

The psychopathology of those psychoneuroses which cannot be satisfactorily explained or successfully treated on the principles already described is necessarily complicated, since it must take into account many aspects of mental development from infancy onwards, and not only mental processes but fundamental tendencies (i.e. instincts and interests based upon them) of a kind which are but little apparent on the surface of everyday life.

It may be asked why it is necessary for the understanding of a psychoneurotic condition in an adult to take into account the happenings of infancy or childhood. The answer is that deviations of development can arise at any stage, and that their effects do not stop there, but may prejudice the future development to an extent that makes normal living impossible. Dissatisfaction results and shows itself in symptoms which may at first seem to be explained by contemporary circumstances, but are shown, by the failure of attempts at therapy devoted merely to these, not to be so explained.

Influences of faulty training

Insufficient emphasis is laid at the present time on the importance of faults in early training in the development of psychoneurotic reactions. So much attention is paid to recondite 'mechanisms' that the simpler facts are overlooked. Yet it is clear from the study of neurotic children that such influences as heighten the child's self-esteem (spoiling) or increase his sense of the dangers of the external world (over-protection), or, on the other hand, diminish unduly his self-esteem (lack of parental affection or repeated blame), all favour the development of psychoneurotic conditions in adult life as much as in childhood. Training in general and in the more literal sense of discipline, education in manners, and religious education play a part in determining whether the child later develops a psychoneurosis or not. Upbringing in the sense of the 'atmosphere' of the house, whether it is harmonious or not, is of known importance in determining what a child feels about life, his own self-confidence in facing it, and what he expects of it. It has been said that a psychoneurosis is either an attempt to get what one has never had—and things lacking in the early family environment are all important here—or to reinstate what one thinks one had (an attempt to reinstate a 'golden age' of early childhood happiness). All these influences may be regarded as moulding the child's ego and as making him arrogant, conceited, timid, insecure, 'inferior', or even in his own view of himself vaguely guilty as the case may be.

Developmental basis of psychoneuroses

It is convenient to discuss developmental psychopathology in more detail from two angles. (i) The complicated mental 'mechanisms' which are found to be the basis of symptoms. These processes are normal, and it is only when they do not completely achieve their aim that symptoms and signs of mental ill-health appear. The chief of these 'mechanisms' is subsumed under the term 'repression'. (ii) The motive forces which activate these processes—the inner instinctual urges and the environmental influences—are the two sets of factors between which the individual ego has to hold the balance.

General assumptions

Determinism

Purpose

Some basic assumptions in psychopathology have a practical justification in that they appear to work. The first is the fully determined nature of mental events. Each is explainable in terms of what has gone before. This must be combined with the conception of purposiveness in mental processes. If it be asked how determinism and purposiveness can be reconciled, a parallel may be drawn with the locomotive, in which each movement is a strictly determined part of a total design—the totality of movements which result in the impulsion of the engine along the track, such impulsion being the 'purpose'. The human machine is different from the locomotive in that it appears at least to be capable of controlling its own purposes. It must be assumed that it is, and that it is capable of visualizing its goal or destination, and moreover that this image or vision of a goal comes to be one of the antecedent, i.e. determining, factors in its activity. With the hypothesis of determinism and of determinism by final as well as by antecedent causes the necessary assumptions have been made.

Unconscious mental processes

It is also necessary to conclude, although this is not observed so much as deduced with certainty from observation, that 'mental' is not synonymous with 'conscious'. A great many mental processes are conscious only sometimes and for the rest of the time seem to remain inactive in the mind. For example a man may possess a considerable knowledge of Chinese and yet not use it and hardly think of it except when he is in China. Few would deny that this knowledge is in his mind at all times but only at intervals becomes conscious. Consciousness is concerned with mental activity involved in making an adaptation to the environment at the moment; all other knowledge is, for that moment, not conscious. Modern psychological researches show that there is another kind of not-conscious: remaining out of consciousness not simply because it is not required but because it is actually ejected by other elements in the mind. This is what is meant by 'repression', namely, that certain mental processes are barred from becoming conscious by other mental processes which succeed in repressing them. Conflict between two sets of mental processes produces repression of one of them; an analogy is the 'reciprocal inhibition' of, for example, the flexors and extensors of the knee-joint.

Repression

Repression has several consequences: (i) there is a lacuna in the mind (amnesia); certain events are forgotten and cannot be recalled; or (ii) certain tendencies are replaced by others of an opposing quality (e.g. certain character traits); (iii) if repression is not completely successful, the repressed tendencies or memories may continue to operate and manifest themselves indirectly by producing behaviour which the individual is not able to account for, e.g. automatism, or discomforts such as a mood or a fear for which the subject can find no conscious reason (e.g. a phobia). This is not to say that repression is the only source of symptoms. A conflict of which both terms are conscious, e.g. a feeling of what is required by duty and a desire to escape from it, may equally produce symptoms which are the direct outcome of the psychophysical tension produced by the conflict for the 'final common path' of action. In this event the subject, although he may know of the conflict, may not know that the symptoms are the result of it; they may then engross his attention and enable him to shelve the conflict for a time at the price of a neurosis.

Instinctual urges

Self-assertion

There has been an approximation in recent years between the Freudian and other schools of psychopathology in the importance of what is called by some the instinct of self-assertion as a cause of symptoms. The Freudian view is that aggressiveness is a quality of instincts in general, but especially of the self-assertive instincts. Such early phenomena as the biting of the nipple by the suckling is an example of aggressive impulses; in general the term includes all the impulses which are in the natural course of development directed towards mastering the environment. Jealousy, for example, that frequent cause of symptoms in children, is classified as an aggressive impulse.

Jealousy

Self-assertion in the usual sense comes into the picture very early in the matter of upbringing. The Freudians see some of the earliest possibilities of conflict here, e.g. in toilet-training, which is clearly one of the earliest fields of conflict. They regard toilet-training as an important ground of conflict with parental discipline, because of the emphasis that the latter is apt to lay on duty and cleanliness in this respect, and because of the parental tendency to identify goodness with cleanliness. Cleanliness comes therefore to be next to godliness in the eyes of many young children.

Toilet-training

There are individual, probably hereditary, differences in the amount of aggressiveness and of self-assertion. The resultant characteristics are a combination of this and of the mental imprints made by environmental restraint or discipline, lenient or severe.

The results of these two early tendencies—the innate aggressiveness and the perception of adult restraint—are of two kinds, (i) character traits, and (ii) symptoms.

Character traits

Character traits consist in either the more or less direct expression of innate tendencies comparatively untempered by environmental influences, e.g. the 'wild boy', or in a reaction induced by environmental influences against the innate self-assertion, and similarly against one of the group of sexual impulses. If the reaction is against innate aggressiveness (excessive self-assertion) there may arise abnormal submissiveness, for example, as a counterpoise to the inner urge; or the result may be a strenuously exacting conscience keeping constant ward against the aggressiveness lest it break through, the strength of this conscience being determined, on the one hand, by the strictness of the environmental discipline, e.g. severe parents, and, on the other, by the necessity for being strong to withstand the strength of the aggressive impulses.

Symptoms

Symptoms resulting from the conflict between innate tendencies and the impression produced by environmental restraint consist on the one hand in anxiety, which is originally the child's fear of the strength of his own inner impulses or of the might of adult disapproval of them. These impulses may quite normally in a child amount to desires to destroy persons he is expected by the environment to cherish—the 'death wish', so called. On the other hand, symptoms may consist in obsessive thoughts and compulsive actions, which are either magic attempts to prevent the impulses arising into full consciousness or methods of atonement for their doing so. The impulses are endowed with magic efficacy by the child, in that he believes that they may take effect simply from his having thought them (compare the sympathetic magic of primitive peoples). A third result of conflict consists in feelings of guilt, which mean that the environmentally tutored ego assumes the blame which the child believes the parents and their substitutes would attach to him for his impulses if they knew of them. This guilt is expressed most simply in a feeling of inferiority, although it is not the only source of feelings of inferiority, or more readily in depression of spirits. For example, in the French film *Poil de carotte* a small boy tried to hang himself and, when asked to explain his action, said 'I did it because I do not love my mother', so blaming himself for the lack of affection that he felt he was expected to feel. Symptoms of ill-health may sometimes be a further outcome of guilt feelings, being regarded as a punishment for the possession of such impulses.

Feelings of guilt

Such characteristic symptoms may persist throughout life or become modified or disappear. They may sometimes be aroused in later life when some external situation stimulates the old impulses once more, e.g. the death of a once-hated rival may re-arouse self-reproach. In old age also, with the decline of mental powers and consequent disintegration of the mental arrangements, the old defences break down, and the feeling of guilt may again become excessive.

Sexual instinct and its development

Similar results of conflict appear when the sexual rather than the self-assertive impulses are involved. The particular form of the results is complicated by the forms of sexual impulses possible in any individual, which are also responsible for the phenomena known as sexual perversions; these, taken as a whole, illustrate the multiplicity of the possible sources and directions of sexual feelings and aims. Sensuous rather than sexual is perhaps the better expression for the subjective experience that goes with these impulses in early life. What is known of these early impulses, and of the consequences of their becoming misdirected, in relation to the formation of symptoms, is due mainly to the discoveries of Freud, and for more detail on this topic reference should be made to the article PSYCHOANALYSIS (p. 214). There is, for example, evidence that a sensuous quality exists in sucking and even in biting, although in the latter activity aggressive impulses are mixed with the sensuous. Accidental over-emphasis of any of these early activities and perhaps sometimes constitutional factors may lead to curious results. Pleasure in sucking may be prolonged as thumb-sucking, and in phantasies which, when put into action, lead, in combination with other factors (see SEXUAL BEHAVIOUR AND ABNORMALITIES), to the perversion known as fellatio. The satisfaction of biting may be apparently smothered by conscience, with the result that a guilt feeling becomes associated with the mouth-zone, e.g. the patient may be self-conscious about eating in the presence of others. Such guilt feeling in the case of the mouth-zone arises in association with phantasies, i.e. cannibalistic ones towards other children or the parents. If the possibility of cannibalistic phantasies seems far-fetched, it may be well to recall the common nursery threat 'I'll eat you'.

Oral impulses

Fellatio

Anal impulses

Sensuous satisfaction is also possible from the anal zone. Here again accidental over-stimulation and constitutional factors may lead to accentuation of the sensuous feeling in this zone with associated phantasies, which may be repressed with persistent guilt feeling; or the phantasies may receive partial expression in later life in the perversion known as sodomy.

Sodomy

Phantasies involving the anus are complicated by its association with faeces, which are objects of interest to the young child, an interest which he is taught strenuously to overcome. Freud described an 'anal-erotic character' resulting from over-preoccupation with anal functions, its outstanding features being orderliness and obstinacy. His analysis of this type of character illustrates the principal Freudian hypotheses about the formation of character traits.

The orderliness of this anal-erotic character is held to be the reaction of the conscience against the messiness of which the child feels itself accused in its pleasure in faeces. Miserliness is regarded as a sublimation of the pleasure in faecal retention, and obstinacy as a perpetuation of the habit of defiance of the parent involved in this retention. It is not meant that this is the origin of all pathological obstinacy, since any mismanaged struggle may impress obstinacy on the character of the child; for example too great a struggle over weaning and other mistakes in upbringing may have a similar effect. Genital satisfaction is possible from a very early age—witness the masturbation of infants—and, as time goes on, sensuous feelings become normally most intense, and virtually localized, in the genital area, although erotic sensibility persists normally to some degree in other regions, especially in the mouth and breast zones.

Genital impulses

Educational influences together with phantasies which undergo repression may considerably inhibit the possibility of genital satisfaction, and this inhibition in its extreme form shows itself as impotence in men and as frigidity in women. I doubt if educational influences alone ever do this in any lasting way; more important is the relation of the child to its parents, which in the ordinary family is triangular; but only in some instances does the triangular situation reach the intensity or quality which gives it pathogenic significance. In these cases the boy child is jealous of his father's relation to his mother and may form such an attachment to her that even in later life no other woman may be comparable with her in his conscious feeling, and, because of the repressed phantasies with regard to her, he may find himself inhibited sexually. He is then impotent towards all women because of his over-idealization of his mother and the consequent unthinkableness of sexual feeling (genital satisfaction) with anyone resembling her, i.e. any woman whatsoever. There is no doubt that in boy children erotic phantasies involving the mother may occur. The repression of these may be so intense as to involve all genital feeling in the non-discriminating all-or-none way typical of emotional processes.

Oedipus complex

Similarly, a girl may grow up frigid as the result of her attachment to her father and may feel that the only man she could fall in love with would have to resemble her father, and that such a relation must be asexual. These are the approximate outlines of the 'Oedipus situation' in the boy and the corresponding situation in the girl. Sometimes the boy escapes to some extent from the resulting inhibition by means of the phantasy that there are two kinds of women, the ideal type resembling his mother who are good and asexual and the prostitute type who are sexual objects and nothing else. Sexual experience is possible then with the second group, but marriage is impossible with any. Psychoneurotic anxiety may then arise on confrontation with any sexual experience or with the possibility of marriage, or simply at the prospect of having to leave home and the close association with the mother; or spontaneously, because presumably the repressed instinctual drive finds no conscious outlet of any kind, even in phantasy. Another possible result of the Oedipus complex is homosexuality, in which the sexual impulse escapes complete repression but only at the cost of being diverted towards the patient's own sex (see PSYCHOANALYSIS, p. 222).

Homosexuality

With all these results of conflict, whether character traits, symptoms, *Super-ego or conscience*

or perversions, the all-important factor is the conscience, which often acts automatically, i.e. unconsciously, as the super-ego of Freud. This is conceived to be the mental representation of parental precepts and prohibitions or similar impressions from anyone in authority. Moreover, as Freud has emphasized, the strength of the conscience is apt to be reinforced by the necessity for resisting the strength of the individual's own impulses. A similar strength is attributed to the voice of authority, so that it is pictured as a severe condemnation of the inner urges and impulses of which the individual is aware.

(4)—Clinical Picture and Classification

Neurasthenia

Irritable weakness

The psychoneuroses are commonly grouped according to the more prominent symptoms, but such differentiation does not always correspond to anything fundamental or even important. The term 'neurasthenia' has been used to designate one subdivision of the psychoneurotic group characterized by symptoms of what has been called irritable weakness, such as ready fatigability, irritability of temper, hypersensitiveness to sounds and other stimuli, difficulty in concentration, and broken sleep. When such a syndrome is a true psychoneurosis, i.e. the result of mental conflict, it is produced in exactly the same manner as the other psychoneurotic conditions; in fact, the so-called 'neurasthenic' symptoms are simply the more obvious symptoms in a picture in which others of the anxious, obsessional, or hysterical type can also be detected. The truly neurasthenic irritable weakness is not usually the result of mental conflict but is the result of debilitating experiences, either physical illness or severe emotional strain, over a long period and is better designated by the German term 'hyperaesthetic emotional state of weakness', which gives a good symptomatic description of the condition.

Similar symptoms sometimes appear at an early stage of mental disturbances other than psychoneurotic, for example, in the early stages of organic brain disease or of any psychosis. 'Neurasthenic' symptoms may also appear in those who might be called 'congenital neurasthenics', people usually of the asthenic habitus who have always shown poor capacities for endurance of any kind. It is difficult to discount in them entirely the effects of faulty upbringing; but it seems possible that there are a few people so subnormally endowed that contact with the most ordinary strains of life leaves them tired and with aches and pains and headaches for which no physical basis can be found.

Classification

The principal kinds of psychoneuroses are: (i) anxiety psychoneuroses, or in Freudian terminology 'anxiety hysteria'; (ii) hysteria, in Freudian terminology 'conversion hysteria'; and (iii) obsessive-compulsive psychoneuroses, or obsessional and compulsion psychoneuroses.

Interchangeability of symptoms

The various types of symptoms represent different kinds of outcome of similar mental conflicts and to some extent are interchangeable in the same patient, so that hysterical symptoms, e.g. paralysis, may give place to symptoms of anxiety, e.g. palpitation with anxious fear.

Anxiety psychoneuroses

The mental symptoms of anxiety psychoneuroses are preoccupation with some topic of which the patient is afraid, especially of bodily disease; morbid fears of external situations (phobias), e.g. of heights, enclosed spaces, and travelling; depression of spirits, irritability, and lack of concentration. The bodily symptoms and signs are those produced by emotion, e.g. palpitation and precordial pain; tachycardia, breathlessness, sighing; dyspepsia in the form of flatulence and a feeling of fullness and heaviness in the epigastrium usually without pain; diarrhoea; frequency of micturition or difficulty in micturition especially in the presence of illness; tremors, hot and cold flushes; paraesthesias, e.g. pins and needles, pain anywhere in the body, and headaches, usually in the form of pains in the head or a tight feeling round the head or pressure on the vertex. Occasionally other symptoms or signs, such as spastic colon, migraine, urticaria, and prurigo, result from emotional or psychophysical tension on a constitutionally predisposed individual. The clinical characteristic is the association of mental uneasiness with some bodily expression of that uneasiness; and upon this bodily uneasiness the patient commonly, although not invariably, focuses his attention. There is some confusion in terminology because, whenever mental uneasiness is expressed in physical symptoms, the Freudian practice is to speak of 'conversion hysteria'. It is advisable to keep the term 'hysteria' for cases in which the bodily signs predominate and the mental uneasiness, on the surface at least, is hard to see. In cases in which phobias (fears of external danger from apparently harmless objects) are the main feature there is often little or no bodily unrest or at least none in which the patient takes particular interest.

Mental symptoms

Bodily sig and symptoms

Combinati of mental and physic symptoms

'Conversi hysteria'

The old term 'anxiety neurosis' was intended to imply that bodily symptoms of the sort described could arise from a purely physiological state of excitement without any psychological, i.e. mental, cause. This usage was based on the hypothesis that such bodily symptoms were always due to physical sexual excitement without satisfaction; but it now seems unlikely that they arise on physiological grounds alone. It is true, especially in some women, that physical symptoms, such as aches and pains, arise in circumstances of sexual excitement without satisfaction, but it can hardly be said that the mental factor, in the form of preoccupation and irritation over the unsatisfactory state of affairs, is ever absent.

'Anxiety neurosis'

Hysteria is not one disease but a name which covers the modes of reaction of many different individuals to different circumstances; but from the symptomatic standpoint the description of hysterical symptoms as being in some sense the outcome of dissociation or morbid independence of certain mental functions of the rest of the psyche is still good; for example, a limb may be paralysed in such a way that, although physically there is nothing amiss, it is outside the subject's capacity to move it, and yet in a hypnotic state he can be made to move it; on the other hand, the dissociation may be shown purely in the mental field

Hysteria

and the patient may lose an island of memory from his life-experience, which, however, may be recollected when his ordinary consciousness is in abeyance, as in hypnosis.

Types of symptoms: motor

The symptoms of hysteria are motor, sensory, visceral, trophic, and mental. Motor symptoms include paralyses and in some cases ultimately contracture, tics, gross tremors, mutism, and aphonia. The paralysis has none of the characteristics of an organic paralysis either peripheral or central; tendon-reflexes are not altered, or if they are it is in the direction of exaggeration, and skin-reflexes are not qualitatively changed. There is often voluntary exaggeration, the patient jerking his limb before the tendon is struck. If he is asked to contract the paralysed or paretic muscles, the effort he makes goes equally into the antagonistic muscles, and little or even no excursion of the limb is produced.

Sensory

The classical sensory symptoms are forms of anaesthesia, but paraesthesias and hyperaesthesias also occur. The anaesthesia does not follow any anatomical distribution. Characteristically, like the motor symptoms, it follows the patient's concept of what the symptoms ought to be; for example hemianaesthesia sometimes occurs and stops abruptly at the middle line, and peripheral anaesthesia is of the glove-and-stocking type. It is very easy to suggest anaesthesia to hysterical patients. Anaesthesia of the special senses also occurs; hysterical blindness and hysterical deafness are not uncommon. Concentric diminution can occur in the visual field and is commonly spiral, i.e. repeated perimetric measurements show progressive narrowing of the visual field. Pupillary reflexes are usually intact, but occasionally failure of accommodation is seen, presumably because the patient does not really co-operate but only makes a display of doing so. Squint is possible as an hysterical symptom in patients who are normally capable of voluntarily dissociating the movements of the two eyes.

Visceral

Of visceral symptoms, anorexia nervosa, which characteristically occurs in young married women, is the most interesting (see Vol. I, p. 598). Excessive appetite and loss of appetite also occur. Respiratory tics are occasional symptoms.

Trophic

Of the trophic symptoms the best known are the cyanosis and sometimes oedema of the hysterically disused limbs. Secondary changes occur also in the nails and in the skin of the disused limb, but are soon abolished when the limb is used again. Artificial skin lesions vary according to the methods used to produce them (see Vol. III, p. 617); possibly some are produced in a state of mental dissociation, i.e. in a condition of automatic activity for which the patient has amnesia afterwards, but in most instances in which the patient pleads forgetfulness this is wilful and not automatic.

Mental

Amnesia is the best known mental symptom and is insular as a rule, i.e. for a circumscribed set of events in the patient's life. In a number of instances, however, it involves the whole of the patient's previous life up to a certain date. The other mental symptoms are somnambulism, fugues, trances, delirium, dreamy mental states, and apparent loss of consciousness—apparent so far as any notice is taken of the external world. This loss of consciousness most often follows convulsive seizures.

Obsessional psychoneuroses

Obsessional psychoneuroses with or without compulsions (synonyms, psychasthenia and obsessive-compulsive psychoneuroses) are characterized chiefly by preoccupation with ideas which the patient knows to be abnormal and which he is unable to inhibit, for example, preoccupation with a phrase which has ceased to have any relevance; or compulsive conduct, such as a feeling of being forced to arrange his clothes in a certain way in the chair when he goes to bed at night or to repeat certain formulae over and over again.

(5)—Prognosis

It is difficult to lay down general rules upon so diverse a group of conditions as is represented by psychoneuroses, but there are a few principles of prognostic value.

Constitutional factor

The less a constitutional element enters, the better the outlook as a rule. Patients with a large endowment of anxiety evident in their own temperament and reflected in the family history, those with hysterical personalities rather than hysteria, and patients with strongly-marked obsessional traits from an early age have much less chance of a complete recession of symptoms.

Obsessional types

It has commonly been supposed that obsessional psychoneuroses are more obstinate than the other types, but clinical experience shows that a considerable proportion recover. According to Lewis 50 per cent get well, by whatever method they are treated, or even if they are not treated at all. The criteria of what constitutes an obsessional psychoneurosis vary considerably with different observers. The term is often applied to conditions with much anxiety and 'obsessional' traits of character, especially over-conscientiousness, whereas others confine the term to cases in which the patient is preoccupied with actual obsessional thoughts or compulsive actions. The latter is the traditional usage; but even here better results are occasionally obtained by psychotherapy than was formerly thought possible.

There is undoubtedly, in a considerable proportion of cases, some degree of spontaneous recovery, the symptoms receding at least for a time, often to break out again. The approximate spontaneous recovery rate is difficult to estimate, especially since what appears spontaneous may often be found on closer examination to depend on some alteration of circumstances. Some of these changes of circumstances are of a kind that could not have been arranged therapeutically; for example, the death of a near relative is sometimes causally related to recovery, the existence of the relative in question having been a barrier to psychological freedom which the patient had been unable to overcome. But it seems probable that for psychoneuroses of long duration the spontaneous, i.e. untreated, recovery rate is low. On the other hand, it is not infrequently remarked after adequate and radical treatment that the patient has never been so well before; untreated, such conditions, whether anxiety psychoneuroses, hysterias, or obsessional states, appear to be capable of lifelong duration.

Prognosis of anxiety psychoneuroses and hysteria

The best authenticated results, based on systematic follow-ups of more than 1,000 cases over many years, are those of Ross for anxiety psychoneuroses and hysteria. The combined recovery rate in the two groups is approximately 75 per cent when treated by re-education, persuasion, or analytical psychotherapy.

Psychoanalysis

The only statistics available from the psychoanalytic school are those from the Psychoanalytic Institute in Berlin, which were obtained by a group of psychoanalytic therapists and show the following results (Hendrick).

TABLE I.—Results of Psychoanalysis in Psychoneuroses

DIAGNOSIS	NUMBER OF CASES	TREATMENT INCOMPLETE	TREATMENT COMPLETE	RESULTS	
				MUCH IMPROVED	CURED
Anxiety hysteria	57	25	32	6	14
Conversion hysteria	105	31	74	21	25
Compulsion neuroses	110	35	75	26	21
Neurotic inhibitions	80	24	56	15	21
Neurotic depressions	37	13	24	5	7

(6)—Differential Diagnosis

Since this would involve practically the whole of clinical medicine, it is useless to attempt a complete discussion. There is no system disease of which may not be simulated, and no disease which may not be imitated. It is important for the practitioner to realize that many conditions loosely diagnosed as 'anaemia', 'gastritis', 'rheumatism', and the like (in which no sound pathological basis has been found, such as haemoglobin of less than say 60 per cent or achlorhydria) are really psychoneurotic, the symptoms of visceral disturbances being the outcome of emotional distress. Out of 1,289 cases at general medical out-patients, Bruce Pearson found that 16 per cent were without physical lesion and were really the victims of emotional distress. Halliday, in 1,000 cases referred to him as Regional Medical Officer under the National Health Insurance Act, found a percentage of 35, the majority of whom had the above diagnoses and other similar ones attached to them.

The practitioner must beware of two errors—the diagnosis of physical disease on the basis of symptoms which are purely emotional in origin, and the attribution of causal efficacy to a lesion, e.g. a carious tooth, septic tonsils, or a chronic appendix, which may have no relation to the symptoms. These errors can usually be avoided if, as part of every routine examination in which there is any doubt whatever about the presence and relevancy of a physical cause, an attempt is made to ascertain the state of the patient's mind. This can be done by simply taking a careful history of the personal events preceding the onset of the illness, and by directing inquiries to conditions at home and at work to discover whether the patient is happy, anxious, disappointed, dissatisfied, jealous, or envious, in any of the more usual relationships and situations in his life.

When it has been established that the condition is mental in nature or psychological in origin the differentiation from other conditions of mental type or origin must also be considered, especially those usually called psychotic, which are predominantly constitutionally or physically determined. 'Neurasthenia', anxiety psychoneuroses, and hysteria are often simulated by early organic brain disease, by the early stages of schizophrenia, and by manic-depressive and toxic-exhaustion psychoses. Only a careful physical examination will settle the matter in the case of organic brain disease or toxic-exhaustion psychoses; in schizophrenia the previous personality, the mode of onset, and a certain oddity of thought or manner may give the clue. The most frequent and most difficult task is the differentiation of depressions of constitutional type from those of mainly reactive or complex-determined origin, i.e. from psychoneuroses in which depression is the main symptom. A family history of similar illnesses, a sudden onset in perfect health, a subjective experience of lack of interest in, or of inability to enjoy, anything, a feeling of difficulty in thinking, or a tendency to self-accusation are all in favour of a constitutional type of depression; but the only more or less final test is the therapeutic one, since only severe depressions are easily differentiated.

From organic disease of the brain

From schizophrenia

2.–PSYCHOTHERAPY

(1)—General Treatment

1316.] The remedy depends on an analysis of the causes: how much is extrinsic and how much intrinsic, and, if mainly the latter, how much is constitutional and how much acquired (by training or the accident of complex formation). If the important factors appear to be environmental, it may be possible to modify them. But it must be certain, before reaching such a conclusion, that the patient is not deceiving the physician as well as himself into believing that the fault is extrinsic and not in his own weakness of character or faults of temperament.

Change of environment: children

In children especially it may be the environment which must be treated rather than the child—parents who require sound education on how to bring up the child or how to behave towards one another, or a school that is not suitable, a teacher who is difficult, or a headmaster who does not understand the child's difficulty whether of intelligence or temperament. It is striking how a psychoneurosis in a child may be modified by a mere change of environment. Tests of intelligence are often useful to indicate the direction which treatment must take; not only are clues obtained as to the existence of stresses at school but the manner in which the child approaches the tests is often a useful indication of temperamental characteristics. *Adults* In adults with the simpler problems the same is true; to be removed from certain circumstances may be enough to allow the symptoms to subside. I have known even psychotic conditions much relieved, at least temporarily, in this way and many psychoneurotic and reactive conditions lastingly improved. Removal from the trying environment is a form of rest, and rest is now insufficiently utilized, at least in the treatment of conditions of anxiety. *Adolescents* Among adolescents change to an occupation more in accordance with the patient's abilities is more suitable and may be very successful. Vocational guidance by an expert plays a part here; but again it is important to be certain that the nature of the occupation is a real factor and not simply a scapegoat for inner difficulties.

General advice to patients Many people with psychoneurotic symptoms are living foolish lives and must be advised accordingly. A few are greatly helped by instruction in their sex life, about the technique of either intercourse or contraception. Personal difficulties in marital life, however, are more frequent causes of distress than sexual ones, and a family practitioner should be able to advise on home life.

Psychotherapy Whenever the difficulties are mainly intrinsic, one of the methods of psychotherapy must be used, according to the particular problems and possibilities of the case (see below).

Symptomatic treatment Symptomatic remedies are sometimes permissible, e.g. hypnotics for sleeplessness, but usually only sparingly. Sometimes a hypnotic makes the patient comfortable enough to live with his neurosis so that he no longer feels the need for radical treatment. Medicines for symptoms, such as dyspepsia, are best omitted, since they suggest to the patient that he has a lesion, when the practitioner is trying to teach him that he has not; but they may be used in the simple-minded or ill-educated who may be too dull to grasp even simple explanations, or for a time while they are being taught to do so. Sometimes to send the hospital patient away without his bottle means that he will go back to any department other than the one where his psychological difficulties are fully appreciated.

(2)—Psychotherapeutic Methods

The principal methods of psychotherapy may be described according to their degree of intricacy as suggestion, re-education, persuasion, and psychoanalysis. The last name is given, in the strict sense, only to the method which was invented by Freud and is described under the title PSYCHOANALYSIS (see p. 213). A number of modified forms of the method have arisen, in which certain aspects of the Freudian hypothesis are not accepted or not made use of, and which are variously known as analytical psychotherapy, psychological analysis, and the like. The Adlerian and Jungian schools are the best-known offshoots of the Freudian. They have evolved systems much less complete and comprehensive than the last. The above methods are not entirely distinct.

Psychoanalysis for example includes inevitably some suggestion and persuasion; and any method that goes deeper than mere suggestion and re-education is bound to involve some of the principles of psychoanalysis.

The basis for any form of psychotherapy is accurate history-taking, and in a sense even psychoanalysis and the related methods are but an elaborate kind of history; but a history of ideas rather than of events, a history re-lived, and obtained against some of the inclinations of the patient. Suggestion and re-education require, strictly speaking, only a diagnosis before they are put into action, although no one should attempt to arrive at a diagnosis without taking a careful history. Suggestion is described elsewhere (Vol. VII, p. 37). Re-education is applicable in its simplest form to hysterical paralysis and hysterical disabilities generally: blindness, deafness, aphonia, and abnormal gaits. Persuasion also enters. The essentials for re-education are time, complete conviction of the correctness of the diagnosis and of the efficacy of the method, and patience: and it is very much better, once the method has been decided on, if a session is allotted which is long enough to make it likely that the condition can be cured at a sitting.

Re-education

Having explained to the patient that his legs are evidently sound, or his eyes intact, and that his disability depends on lack of confidence followed by disuse and the habit of not walking, or not looking, or not listening as the case may be, the practitioner proceeds to persuade and exhort the patient to walk, look, or listen. Every advance is seized upon and made the most of. Every little step that is made by the paralytic, every sound that emerges from the aphonic, is hailed as evidence of the truth that the function is only waiting to be used. The practitioner must be convinced of his ability to cure the patient; the slightest hesitation in his voice produces a counter-suggestion and instils a doubt or gives the often reluctant patient a loop-hole of escape. Persistence is essential.

I have spent the whole of an afternoon over a patient of this kind, but it was an afternoon rewarded with success. To have left the patient in the middle of the process of getting well would have left an impression of partial failure, which might have taken weeks of work to eradicate.

It is sometimes desirable to indicate to the patient that the explanation propounded to him about the origin of his condition will in no way be indicated to friends or relations. I have known an hysterically paralysed patient say 'Don't make me well too quickly, or what will my relations say?'

Persuasion

Re-education in the above sense is not applicable when the disability is not gross, i.e. not hysterical in the ordinary sense. The process that must be applied when the symptomatic form is an anxiety psychoneurosis or an anxiety hysteria can be called, in its simplest form, persuasion; and this is applicable chiefly to conditions that are the outcome of some actual situation, past or present. This consists essentially of: (i) A careful physical examination. (ii) A systematic and chronologically detailed history of the symptoms in relation to the patient's personal history, career, and so on. (iii) An explanation to the patient that (*a*) he has no physical disease, but (*b*) that his symptoms, however, are real and must have some definite cause. (iv) An explanation of the effects of the emotions on the viscera, with some account of the subjective accompaniment of the visceral disturbances. (v) An explanation of the effect of false inference—i.e. that the symptom is due to bodily disease and not therefore avoidable by him—in perpetuating his symptoms and in making him expect to have them. (vi) He is then encouraged to increase his activity, not gingerly by inches but by leaps and bounds. As there is nothing physically wrong with him, and only his own misconception and discouragement based on this prevents him from being perfectly normal, he can use the supposedly disabled function (e.g. his cardiac function) as much as he pleases.

Explanation to patient of effects of emotion on viscera

It is useful to adduce instances of the known effects of emotion on the viscera. It is common knowledge that fright causes the knees to tremble, but few people know that the general, and especially the visceral, effects of emotion are so definite; in fact it is unusual for them to realize that such effects exist at all.

Oddly enough, most people are more impressed if a scientific experiment can be exhibited to them than if the fruits of clinical observation of the effects of fear on the human organism are explained. It is usually effective to begin with a description of what goes on in a cat's abdomen when it is frightened by a dog and then to point out the homologous occurrence in the human interior. The classical experiment of the observation of bowel peristalsis through a mica window in the cat's abdominal wall is a particularly useful illustration. To more squeamish patients it may be pointed out how the hair on the back of a dog's neck rises when it sees a potential enemy, and the parallel occurrences in its internal organs may then be mentioned. For those of a religious upbringing the existence of a Biblical precedent is impressive. They may be reminded that the writers of the books of the Old and the New Testament were unwittingly alive to psychophysiological occurrences, as for example when 'Joseph's bowels yearned over his brother Benjamin' and when, according to the first epistle of John, 'the bowels of compassion were shut up'.

But to convince the patient that he has no disease of body but only uneasiness of mind is only the first step. Even this may be fiercely contested, since patients, except those to whom the original problem has ceased to exist, leaving only a residue of anxious misunderstanding of the symptoms produced by it, have a kind of vested interest in being ill; it may be an escape from a difficulty, or, what is very much the same thing, a method of avoiding its solution, or a way of saving face. At this point the real psychotherapeutic struggle begins. It may be necessary to get the patient to admit that he has been vain or selfish; or that he has been consumed by envy or jealousy—very disturbing emotions capable of producing visceral reactions and mental ones only less pronounced than those of fear. He may have to be shown that he has always expected to be treated as if he were everyone's darling, or that he has exhibited dog-in-the-manger attitudes that would not be surprising in the nursery but are not such as he has been willing to acknowledge as persisting in himself. He may have been taught to think himself delicate and so may have taken refuge behind supposed illness as an excuse to avoid any responsibility in life; or, if a woman, she may have used her symptoms to excuse her performing even the simplest tasks—so that an aged mother waits still upon her daughter; or, at the other end of life, the daughter may remain without a career or without marriage in order to serve an 'invalid' mother whose invalidism is determined by the need to keep the daughter enslaved.

Relation of patient to practitioner

The method of persuasion which is used to get the patient to accept such facts and to see them from another's point of view involves a certain relation to the practitioner. The latter cannot hope to do much unless he continues to receive not only the confidence but in some sense the liking of the patient. It would be very improbable that the treatment could succeed if the practitioner straightway attacked the patient's character. It is essential that first of all a bond of some kind should exist which will make the patient feel that, although difficult things may have to be said, the practitioner is always on his side. Nothing more is needed to unite this bond than a carefully non-criticizing attitude. This situation is analogous to what the Freudian psychopathology calls transference, i.e. that attitude of the patient to the practitioner which includes both an emotional relation and the fact that the practitioner is seen, unconsciously at first, as the replica of some one or a number of people who have had special meaning for the patient during his life. But the method of persuasion takes account only of the emotional content and does not seek or find it necessary to analyse, i.e. to discuss separately and dissect, the unconscious elements in the patient-practitioner relation.

This method of persuasion is useful when the problem is contemporary or at any rate largely extrinsic, and when too much does not depend on the presence of factors in the patient's psychological make-up derived from either inherited traits of temperament or infantile and childhood factors of which the patient is unconscious—'complexes' in fact of early origin. The method nevertheless involves an appreciation of another type of psychological factor of early origin, namely, the kind of character that the patient possesses. This can be demonstrated to the patient in a much shorter time than can repressed unconscious items. The appreciation of disadvantageous traits of personality depends naturally a good deal upon the practitioner's experience of human nature and what may be called, for want of a better word, his intuitive capacity for estimating the character of the patient before him.

Assessment of patient's character and temperament

One of the tasks that any psychotherapist must undertake with any patient in the early stages is an assessment of the assets and liabilities of the patient's character and temperament; for without a favourable balance psychotherapy would be a waste of time. Briefly, the estimate must be based on an appreciation of the relative strength of the instinctive drives, including the general energy of the patient, and of the controlling superstructure of conscience and ideals. When the estimate is favourable, one of the above methods may be proceeded with; but, when the whole is unsatisfactory, the practitioner must ask himself if he should proceed at all, and along what lines. Some personalities will not stand a critical analysis of any kind but may benefit from being supported. Psychotherapy must then be limited to encouragement and direction. Other personalities may seem weak and imperfect; but a survey of the qualities, good and bad, with advice of a purely didactic kind, may be serviceable, whereas an explanatory analysis may be unwise.

A considerable number of people now present themselves to the practitioner in the first instance not for the cure of symptoms but for difficulties depending on faults of personality and character which they recognize but do not know how to cure. Such problems do not lend themselves so well to psychotherapeutic technique as do psychoneuroses in the ordinary sense.

The possibilities of success from re-education and persuasion, and indeed from any method of psychotherapy, are limited by the patient's wish to get well and in the case of psychoneuroses resulting from faulty attitudes to unhappy conditions by something equally important—the capacity to face the situation from which his symptoms present an escape. Some situations are apparently to some natures intolerable, and I have known cures ensue only when, as is sometimes possible, the situation is altered. In an adult that can rarely happen, and when the psychotherapist suspects a difficulty of that kind he must do his best to counteract it, not merely by encouragement but by attempting to analyse those factors in the situation which are difficult. Sometimes a closer examination will show a way out, either because it shows that the circumstances are not what they seem to the patient, or because some small modification in them is possible, whereas a total alteration is not.

Psychoanalysis

The conditions which require a more complicated form of psychotherapy are mainly: (i) spontaneously arising psychoneuroses—hysteria and 'anxiety hysteria'—presumably due to the re-emergence of complex situations of infantile and childhood origin; (ii) obsessional psychoneuroses; (iii) sexual perversions of all kinds, and some cases of impotence and frigidity.

For such conditions the forms of psychotherapy in use are either psychoanalytic in the strict sense or derivative methods. The derivative methods are effective reasonably often and are usually much shorter than the classical psychoanalysis, which to some extent they imitate. The purely psychoanalytic method is described under the title PSYCHOANALYSIS (see p. 228). The shorter methods likewise include dream interpretation and free association but usually dispense with anything resembling 'the analysis of the transference' on which psychoanalysts in the strict sense lay much emphasis. Commonly also the shorter methods are more concerned with the self-assertive tendencies and their metamorphosis and rather less with infantile and sexual ones.

3.–NEURASTHENIA IN THE TROPICS

(1)—Aetiology

1317.] This form of anxiety psychoneurosis is often called tropical neurasthenia by writers on tropical medicine; but the term, as Millais Culpin has emphasized, is inappropriate, because neurasthenia in the tropics does not differ essentially in its clinical aspects from neurasthenia developed elsewhere. I cannot, however, entirely agree with those authorities who urge that neurasthenia acquired during tropical service is not commoner than among the inhabitants of temperate countries.

Neurasthenia in the tropics can be classified as an anxiety neurosis, and it is probable that the special conditions of life in backward tropical countries and the worries inevitable to an isolated life constitute the trigger which precipitates the break-down in those predisposed to neurasthenia.

Fugue

It is even asserted by some, notably by Culpin, that potential neurasthenics actually avail themselves of the opportunity of going abroad 'as a flight from the strain of social life at home', and are therefore more likely than others to be acted upon by the adverse conditions of tropical climates.

Invaliding

Table II shows the incidence of psychoneurosis as an invaliding factor in British Government Departments compared with the staffs in East and West Africa.

TABLE II.—Psychoneurosis as an Invaliding Factor in British Government Departments and in East and West African Governments (after H. C. Squires)

	BRITISH GOVERNMENT DEPARTMENTS	EAST AND WEST AFRICAN GOVERNMENTS
Total wastage during year –	32 per mille	30 per mille
Invalided – – –	5·8 ,, ,,	7·7 ,, ,,
Invalided for psychoneurosis –	0·57 ,, ,,	1·5 ,, ,,
Invalided for psychological reasons – – –	1·0 ,, ,,	2·9 ,, ,,

From the administrative point of view, in the Colonial and other administrative services this psychoneurosis plays a very considerable part in the invaliding of Europeans in tropical countries, and this is especially the case, at the present time (1938), in West Africa, where it is responsible for the greater part of the invaliding rate. No less than 45 per cent of 353 recent invalidings from the tropics were due to psychological causes (Squires), and during the last few years neurasthenia accounted for the greater number of invalidings from the West Coast of Africa, whereas the real tropical diseases constituted only a minor proportion.

Causation

Many views have been put forward regarding the essential factors concerned. Several writers on the subject, notably Acton and Vassallo, believed that the exciting cause of neurasthenia in India and Africa was a depression of the function of endocrine glands, mainly the thyroid and to a less extent the adrenals. This was brought about, they thought, by the direct action of toxins of tropical diseases added to climatic conditions and the poor quality of the food. The sum-total of these stimuli is to produce a condition of hypothyroidism showing a feeling of chilliness, loss of condition of the hair, and a harsh skin. Others consider that these stimuli exert exactly the opposite effect. Stannus, for instance, considered that the special factor involved was the summation of multiple minor noxious defence-inducing stimuli.

Depression of function of endocrine glands

Van Loon, writing from the point of view of the European in the Dutch East Indies, considered that tropical neurasthenia differed from the common type, that in its causes and pathology exogenous factors predominated, and that the latter were found in the hypersecretion of various organs, such as the profuse sweating and polyuria which at first occur under the influence of exogenous physical factors, such as the continuous moist heat and the irritation of the intestinal tract by excessive use of spices. These factors greatly influence the highly developed European mind but do not play any part among indigenous people, unless they have adopted European habits.

Influence of tropical infections

Malaria

Tropical haemic infections, such as malaria, especially the subtertian variety, are potent predisposing factors of neurasthenia and may precipitate any mental state, whether a depression, anxiety neurosis, or schizophrenia. Headache and lack of concentration are sequels of malaria.

Dysentery

Tropical intestinal infections, such as bacillary and amoebic dysentery, may cause undue concentration on the intestinal functions, and mucous colic, which usually has a psychoneurotic factor, may result. Patients from India and the Far East who are suffering or who have suffered in the past from sprue are also usually potential neurasthenics.

Living conditions

Other aspects of life in the tropics are apt to encourage introspection. The general discomforts of life, the heat, the exhaustion, very often the dull monotony, the ever-recurring twelve hours of daylight alternating with twelve hours of night, and the proximity to natives and their sometimes irritating ways all act as stimuli provoking the neurasthenic state. The blunting of the appetite by the heat and general conditions, and the unpalatability of native-cooked food and tinned foods all tend to upset the digestion.

Insomnia

The unrefreshing quality of sleep and the tendency to insomnia, which almost invariably develops in those who live for any length of time in West Africa, are also potent predisposing factors.

Sexual factors

Sexual factors play a part, especially in Europeans visiting the tropics for the first time. Generally speaking, the first effect of a tropical climate upon a young European is to stimulate the sexual appetite and, if this cannot be gratified, or even if it is gratified by intercourse with native women, the effect depresses the higher faculties.

There are others whose mental equilibrium may be upset by the comparative luxury of life in the tropics, the excess of alcohol, late hours, and the luxury of being attended hand and foot by native servants.

Occupation

Mental pressure and undue stress of work appear to be less easily tolerated in the tropics than in the home environment, and it is often true that, owing to the absence of other diversions, those engaged in commercial undertakings are prone to stick to their desk day in and day out throughout the week till they become exhausted. Neurasthenic symptoms are apt to develop also in native officials placed in a position of responsibility.

Neurasthenia in the female

The European woman becomes physiologically unbalanced more readily than the male under the stimulus of tropical heat. The menstrual functions are disturbed, and very often there is a temporary suppression succeeded by menorrhagia. Owing to lack of exercise and to constipation there is a tendency to pelvic congestion, which adds to the discomforts of life, and often this is complicated by uterine displacements. The lack of organized occupation in most women in the tropics, where all the household duties are undertaken by native servants, induces a state of mind which predisposes to the neurasthenic state.

Quinine

In those with an idiosyncrasy the constant absorption of quinine for prophylactic purposes depresses their mental outlook. Quinine may be a direct mental depressant; on the other hand, it may act indirectly by causing indigestion and abdominal discomfort.

(2)—Clinical Picture

Symptoms

The symptoms of neurasthenia in the tropics do not differ materially from those observed elsewhere. The appearance of the patient is characteristic. The emotional state is usually uppermost and is only relieved by resolving into floods of tears, and in men the mental anxiety is often increased by realization of the absurdity of the situation. Another type of patient becomes terribly depressed and may exhibit suicidal tendencies.

Claustrophobia and insomnia

Claustrophobia and insomnia are usually present. The patient suffers from headache localized to the parietal region, or there is a sense of increased intracranial pressure. Others complain of all kinds of *ntestinal ymptoms* abdominal sensations and flatulent dyspepsia; *Tachycardia* tachycardia and vasomotor instability with low blood-pressure are also present. *Reflexes* The deep reflexes are exaggerated, and there may also be a false ankle-clonus. *Tremors* Fine tremors of the tongue, lips, and hands are present. *Perspiration* In tropical neurasthenia the sweat-glands are very active, the patient is usually in a cold clammy sweat, and hyperidrosis of the palms of the hands and soles of the feet is a noticeable feature.

(3)—Treatment

Curative

All these cases must be thoroughly investigated from the medical point of view, if only with the object of obtaining the patient's confidence. *Climate* Usually, when the patient reaches a cool climate, the more urgent symptoms disappear and refreshing sleep is restored. Very often too the neurasthenic state is only temporary and disappears under more congenial surroundings. *Malaria* Chronic malaria may be the underlying factor, and with the disappearance of recurring attacks of malaria a healthier mental outlook is established. *Alcohol* The influence of alcohol is often great. If the consumption of alcohol has been excessive, either restriction in its use or its complete prohibition is beneficial. Efforts must be made to draw the patient's attention away from himself, *Hobbies* and hobbies of all kinds must be encouraged. Nothing is so conducive to this as a fishing holiday in Scotland or Ireland.

Physiotherapy Medicated baths, massage, and electrical treatment are often helpful, *Psychoanalysis* and some cases are much improved by psychoanalysis. *Drugs* Treatment with drugs should consist of giving bromides, e.g. ammonium bromide 10 grains, in excitable cases; and hypophosphites or glycerophosphates, e.g. the compound syrups or the proprietary preparation metatone, in depressed cases.

Prevention of recurrence

It is easier to cure the neurasthenic state than to prevent its recurrence should the patient return to similar conditions of life. Once neurasthenia has developed in a European resident in the tropics and has recurred in a temperate climate, the question of his return to a tropical climate should be very seriously considered. Each case must be weighed on its merits, but, when there has been a complete mental break-down with loss of efficiency, the only course to pursue is permanent invaliding from the tropics.

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PSYCHOPATHIC PERSONALITY

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Reference may also be made to the following titles:

MENTAL DISEASES, PSYCHOANALYSIS
HEREDITY PSYCHOSES

1.–DEFINITION

1318.] Persons who throughout their lives or from a comparatively early age show disorders of conduct of an antisocial or asocial kind, either continual or intermittent, are said to have a psychopathic personality. Most of them reach a high intellectual standard, some are almost defective, but all stand slightly apart from the criminal, the psychotic, the neurotic, and the mentally defective.

2.–AETIOLOGY

In 1835 J. C. Prichard of Bristol first described such states comprehensively, designating them as moral insanity or moral imbecility. He pointed out that it was the affections and feelings, in contradistinction to the understanding and intellect, which were so seriously involved. The condition was thought to depend on an affection of the moral principles of the mind, which seemed perverted and depraved and gave rise to states of anger and impulse, phases of delinquency, eccentricity of conduct, and singular and strange habits.

Previous to Prichard's description other psychiatrists, notably Pinel, Esquirol, and Rush, had recognized the importance and significance of such cases but had not attempted to group or co-ordinate them.

Later, a considerable amount of doubt was thrown on the validity of Prichard's observations, and it was asserted and maintained that moral insanity and imbecility were merely phases in better defined psychoneurotic or psychotic states. That this is not so has been amply proved.

In 1891 Koch first introduced the term psychopathic inferiority, enlarged the scope of Prichard's observations, and suggested that certain hysterical and obsessional states might well be included. It is now generally accepted that psychopathic personality constitutes a large part of psychiatric and penal practice.

The failure to recognize the part which a more or less specific psychopathic disposition might play was due to the tendency to identify the psychopath with the delinquent and to regard the terms as almost synonymous. There is little doubt that psychopathic traits in many instances predominate in delinquency, but there are delinquents who are not psychopathic, and evidence is accumulating to show that a much wider conception is possible. The truth of that statement is borne out by the knowledge that imprisonment, in the psychopathic group particularly, has proved a miserable failure; furthermore, psychoneurotics and psychotics with strong psychopathic elements in their make-up do not respond to treatment in the favourable way in which they otherwise might do.

Causation

The cause is unknown. In some cases there is a strong hereditary factor; in others difficult environmental conditions, e.g. broken homes, poverty, illegitimacy, and parental over-domination, are important; and unconscious factors resulting in emotional conflicts may be fundamental. In every case must be remembered the possibility of correlating the psychological mechanisms with the neuro-physiological and biochemical. To obtain a correct evaluation the individual must be considered as a total personality, including his physics and chemistry, his morphology, his physiological or functional capabilities, his intellectual and emotional make-up, and the healthy-mindedness of his reactions.

3.–CLINICAL PICTURE

There are many persons who do not conform to any psychological category, who are a law unto themselves, and who in many different ways feel at war with themselves and society; they try to dominate the situation by delinquency or by other forms of psychoneurotic or psychotic disorder of conduct. In these circumstances it is not surprising that the signs and symptoms may be extremely varied. In most cases this disordered conduct has been present from early childhood, and people who reach a high intellectual standard may show defects of emotion and judgement which they are unable to correct. There is lack of altruistic feeling, moral blindness, coldness, and selfishness apparently devoid of pity and remorse. Such persons do not respond to kindness or to punishment but are so dominated by their instincts and emotions that recurrent episodes of antisocial conduct tend to recur throughout their lives.

Classification

Whereas Kraepelin classified these cases as (i) excitable; (ii) unstable; (iii) impulsive; (iv) eccentric; (v) liars and swindlers; (vi) antisocial; and (vii) quarrelsome, his pupil, Kahn, tried to analyse them in more detail. He believed it possible to separate quantitative differences or deviations in the personality, and for this purpose he separated those showing disorders of (i) impulse; (ii) temperament; and (iii) ego and character. Attempts to apply this classification are disappointing, because it is impossible to divorce one factor from the others. Kahn tried to correlate these disorders with leptosomatic physique.

Other workers, notably Birnbaum and Partridge, have preferred to study the relation of the psychopath to the social situation and have suggested the term sociopath instead of psychopath.

I prefer to classify these cases into large groups with predominating characteristics, which, however, may not be so sharply delimited as my classification seems to suggest. Although the psychological mechanisms may be in the forefront, yet the parts played by neuro-physiological and biological factors are not disregarded. In the present state of knowledge it is better to work in a wide field and to avoid a detailed analysis so as to prevent pigeon-holing the case material.

My classification is as follows: (i) predominantly aggressive; (ii) predominantly passive or inadequate; and (iii) predominantly creative.

(1)—Predominantly Aggressive Type

The members of this group include the suicide, the homicide, the alcoholic, the drug addict, the epileptoid, and the sex-variant.

All of these, when their condition is uncomplicated by a definite psychotic state, show a disorder of conduct usually of a transitory episodic kind, which in most cases is succeeded by relative calmness and normality with insight. The episode, whatever it may be, seems to 'clear the air', just as an epileptic fit may do. These patients have been difficult, wayward, quarrelsome, touchy, impulsive, and egotistical from their earliest days. They act so suddenly and violently and for such trivial reasons that they can be described as showing a trigger-like reaction, a short-circuit response, which Aschaffenburg described as so characteristic of chance, affect, and opportunity criminals. It is highly probable that just before the deed is committed or at the moment of its commission consciousness is altered, a kind of mental blindness or split-mindedness allowing the perpetration of the most gruesome crimes with apparent ruthlessness and unconcern, e.g. Dr. Ruxton, who murdered his wife and his maidservant and then dismembered their

Split mentality

bodies. Many of these people realize to some extent the dangers to which their impulsive natures expose them, but they are so dominated by their unstable and uncontrolled instincts that they do not reckon the consequences either to themselves or to their victims. Some can be described as narcissistic rebels against society who attempt to square accounts by whatever method appears for the moment most opportune. The aggressive acts may symbolize reaction against the overpowering strictness of the super-ego, but there is no all-pervading mechanism; the facts must be worked out in each case.

The alcoholics, the drug addicts, the so-called affect and psychic epileptics, and the sex-variants are dominated by instinctive drives similar to those in the suicide and the murderer and show in their fore-histories abnormal character traits which at any moment may regress into something more primitive.

(2)—Predominantly Passive or Inadequate Type

The members of this group effect their domination in an almost more subtle and persistent manner. The constitutional background is more loaded hereditarily. This group contains the petty delinquents, e.g. liars, swindlers, thieves, and some of those other types which formerly have been aligned with psychoneurotic or psychotic states. Some are placid facile suggestible types, people who are evasive, lacking in purpose and continued effort, without any sense of honour, and relying on glib explanations and rationalizations. Others are rigid, cold, apathetic, and not altruistic, and never experience remorse. All are detached from reality, living in phantasy and make-believe, so that it is easily understood how they may pass into states of fugue during which lying, swindling, thieving, and misrepresentation are conspicuous. In general they are almost more malignant than the aggressive group; they may never go so far wrong, but they never attain the same success, even though the success of the aggressive group is not sustained. The inadequates readily change from one job to another, seem to lack continuity of effort or sustained purpose, and swell the ranks of the unemployed. In many cases there is no suspicion of any superadded psychoneurotic or psychotic state. The condition remains pure and can be designated as a psychopathic state. In other cases, however, psychopathic personality is an important element in the constitution of psychoneurotics and psychotics and may profoundly influence both prognosis and treatment. The resistant hysterics and obsessional states, the persistent hypomanics, those who suffer from schizophrenic episodes, some of the simplex types, and certain paranoid states would often be much more clearly understood if due allowance were made for the presence of psychopathic traits, which are different from cycloid or schizoid traits.

Petty delinquents

(3)—Predominantly Creative Type

Creativeness, when well developed, approaches the realm of genius or corresponds to it, and genius and states of mental or nervous instability have been recognized as closely allied. It is not an easy matter to define or describe what constitutes genius. It may be thought of as a multiple quality which spreads into various faculties and occurs irrespective of the circumstances in which the person is brought up. A genius must have not only inspiration but also energy to give effect to this extra vision and its valuations in whatever manner suits his talents. Genius is probably not determined hereditarily in any certain or constant manner but crops up in the process of variation and is analogous to a 'sport' in animal and plant life. A study of genius as exemplified by the lives of poets, artists, musicians, statesmen, men of letters, and outstanding personalities, such as Lawrence of Arabia, Napoleon, and Joan of Arc, forces attention not only on the magnificent qualities of leadership but also on the inadequacies, lop-sidedness, and unevenness of their emotional and instinctive dispositions. The great emotional conflicts which occur are solved by attempts at domination closely in accord with the conduct of the aggressive and inadequate psychopaths already mentioned.

Genius

The above formulation, although presented in a summary fashion, indicates that the conception of psychopathic states has grown considerably, and that they have acquired great psychiatric and social significance. They are important first because they are so numerous; secondly, because they are so disruptive of organized society; and thirdly, because there is no adequate provision for them. Their diversity, as exemplified by the group presented, is more apparent than real. They have a common background, a constitutional or acquired predisposition consisting of a psychic immaturity, instability, impulsiveness, and egocentricity, which may discharge in different directions aggressively, inadequately, or creatively according to the predominating psychopathological mechanisms.

4.–TREATMENT

The genius must be considered separately; his advantages to society so far outstrip his disadvantages that it would be presumptuous to attempt to change him.

The aggressives and inadequates, however, require much more thought and effort than have ever been devoted to them. Psychopathic conduct begins in the earliest developmental period, and much benefit may accrue when medicine includes social biology as one of its major subjects, because prophylaxis offers the greater possibilities. Specific rules for the treatment of psychopathic states cannot be laid down, but, if it is appreciated that disordered conduct of every kind can be investigated and understood in relation to the psycho-biological background, then the time may come when practitioners, trained to consider the total personality rather than the particular disease, will approach the serious problem of the psychopath in a more constructive manner.

Even under present conditions the picture is not so black as is sometimes imagined. In these cases the necessity for infinite patience is increasingly appreciated, because many mature and become responsible at a much later date than the average. If a favourable change occurs, it usually takes place before the age of 35 years. Such a more or less spontaneous improvement can be accelerated and increased in frequency by a sympathetic understanding, by a detailed analysis of the life-history with explanations about how situations may be more adequately dealt with, and, in a few specially selected cases, by psychoanalysis. The problem of the treatment of the psychopath, however, is too big a task for psychiatry alone; it is closely bound up with the much wider issues of public health, social welfare, and education. T. H. Huxley is said to have held the view that biology was an essential part of education and that 'education was the best physic for a contented social order' (Adrian).

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ALZHEIMER'S DISEASE
ARTERIAL DISEASE AND DEGENERATION
BRAIN: VASCULAR DISORDERS
CONCUSSION AND COMPRESSION
DRUG ADDICTION
MENTAL DISEASES, HEREDITY
MENTAL ILLNESS, LEGAL ASPECTS
PSYCHOPATHIC PERSONALITY

1.–AFFECTIVE PSYCHOSES

(MANIC AND DEPRESSIVE STATES)

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1.–DEFINITION

1319.] Although affective symptoms can be found in nearly all psychoses, the term 'affective psychosis' is applied to a group of mental illnesses in which disturbance of the affect is the predominant symptom, from which all the other symptoms seem to be more or less directly derived.

Manic-depressive insanity

Kraepelin's 'manic-depressive insanity' represents the affective psychosis in its purest form. Manic-depressive insanity is characterized by states in which excessive cheerfulness or sadness is the dominant emotion. The illness has a periodic course, in which the elevation or depression of mood alternates with free intervals, in which there is complete return to the normal. Besides the two typical affective changes mentioned, anxiety and irritability may play an important part.

Cyclothymia

Depressive constitution

Hypomanic constitution

Round this nucleus may be grouped several related conditions, which are shown by (i) persons of cyclothymic constitution, who are subject to mild fluctuations of mood throughout life, apparently largely unrelated to any obvious external cause; (ii) persons of depressive constitution, whose usual mood is one of slight lassitude and discontent; and (iii) persons of hyperthymic or hypomanic constitution who seem to be always somewhat more cheerful and energetic than the average.

Psychogenic depression

Involutional melancholia

Related conditions which may occur in apparently normal types of personality are (i) the reactive or psychogenic depressions, which start as an understandable reaction to some unhappy experience but show themselves as abnormal in the degree and persistence of the affective change, and (ii) involutional melancholia, the depressive psychoses of middle-age, which are often unique in the patient's life history.

2.–AETIOLOGY

Heredity

Relation to cyclothymia

This is still largely obscure, though something is known about the conditions which may be contributory factors. Heredity plays an important part (see Vol. VIII, p. 555). In a carefully studied group of 100 manic-depressives Lange (1928) found that more than three-quarters had previously shown a cycloid type of temperament. Although this type of personality is not a *sine qua non* for the development of the psychosis, the affinity between affective psychosis and cycloid temperament is aetiologically important, especially since Kretschmer related both to a particular type of bodily constitution (see p. 269).

Pre-psychotic personality

Kretschmer's classification

The pre-psychotic personality of manic-depressives has been characterized by Bumke as showing 'an increased responsiveness for sad and cheerful moods'. Others have spoken of 'an accentuated emotionality in all the experiences of life'. Kretschmer gave a list of qualities of personality, which he subdivided into three groups: (i) the sociable, good-hearted, kind, and easy-going; (ii) the elated, humorous, lively, and hot-tempered; and (iii) the quiet, calm, serious, and gentle. The first group of qualities is characteristic of all cyclothymics, and the second and third of hyper- and hypo-thymic types of cycloid personality respectively. Kretschmer found such types of personality not only among his patients before the onset of any illness but also among their relations, even those who never became psychotic.

Kraepelin's classification

If Kraepelin's original conception of the manic-depressive constitution is adopted, four types may be distinguished (see the accompanying table). They have been considered the 'basic states' from which the psychoses rise like mountain peaks from a structurally similar level plain. The table shows the proportions in which types of constitution are severally liable to different types of psychosis.

Relationship between Personality and Psychosis (from Kraepelin)

CONSTITUTION	PSYCHOSIS		
	DEPRESSIVE	MANIC	MANIC-DEPRESSIVE
Depressive	64·2 per cent	8·3 per cent	27·5 per cent
Hypomanic	35·6 „	23·3 „	41·1 „
Irritable	45·5 „	24·4 „	30·1 „
Cyclothymic	35·3 „	11·7 „	53·0 „

The table shows that the depressive psychosis is commoner than the manic in all types of constitution, even in the hypomanic type.

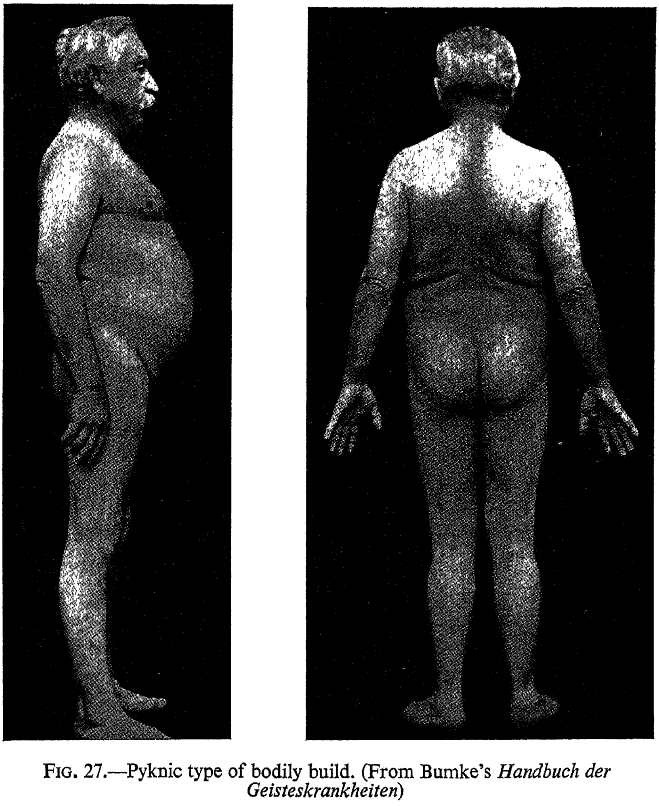

FIG. 27.—Pyknic type of bodily build. (From Bumke's *Handbuch der Geisteskrankheiten*)

Physique
Kretschme
pyknic typ

The pyknic bodily build, described by Kretschmer and associated with the cycloid temperament and with affective psychoses, is seen in its most characteristic form in middle-aged men (see Fig. 27). Large visceral cavities (thoracic, abdominal, and cranial), a tendency to fat on the trunk, especially in its lower part, slightly built shoulder-girdle, and slender extremities tapering to small hands and feet are the main characteristics. A stocky build, a broad face the features of which are not sharp or prominent but rounded like the face, a short and massive neck, and a fat and rotund abdomen complete a characteristic picture. Numerous other more detailed characters may be used for the diagnosis of the pyknic type in young people and in females, who are less characteristic. Anthropological measurements and indices have been used but have proved to be of comparatively little value, because pure pyknic types are comparatively rare, and patients with a few pyknic characteristics, the so-called mixed forms, are difficult to classify. The percentage of pyknics found by Kretschmer in his original material has not been reached by later workers. Subjective judgement in the diagnosis of the type of bodily constitution plays a considerable part. To summarize the certain results of the large amount of work done on this subject, it can be said that the pyknic habitus is commoner among manic-depressives and related psychological types than in the average population (25 per cent as against 12 to 15 per cent), and that this increased incidence is independent of race or country.

Arthritic habitus

The pyknic habitus corresponds to Sigaud's typus digestivus and to the arthritic habitus of French medicine. Arthritics are predisposed to gout, diabetes mellitus, rheumatism, and arteriosclerosis, but seem to be less liable to tuberculosis than the average. A positive correlation between gout and affective psychoses has been established, and a large percentage of mentally healthy patients with diabetes mellitus have been found to be of pyknic constitution (Lange, 1928).

Endocrine glands

The endocrine system, with its evident influence on bodily habitus and its subjection to a biological periodicity, has been held responsible by some for the fluctuations of mood in affective psychoses. Numerous isolated observations support this hypothesis: some otherwise normal women are subject to menstrual or premenstrual depression; the menstrual periods commonly cease during a fairly severe affective psychosis; depressive illnesses are particularly common during the puerperium and at the menopause; manic phases have been observed after thyroidectomy for toxic goitre; and depression often accompanies myxoedema. On the other hand, affective illnesses are rare at puberty and in adolescence, and severe endocrine disturbances of all kinds may occur without any disturbance of the normal affect. One of the observations suggesting an endocrine effect is the different frequency of affective illnesses in the two sexes.

Sex incidence

The admissions to psychiatric clinics and hospitals show that women outnumber men in a proportion of about 3 to 2. It has been pointed out that women are more ready than men to accept treatment, especially institutional treatment; that in men the diagnosis is often more difficult, and the illness is more likely to take an aberrant form, e.g. recurrent alcoholism; and that suicide is commoner in men and may forestall the diagnosis; it, however, seems doubtful that all these factors can account for the whole of the difference between the sexes.

Racial incidenc

Regional and racial differences in the incidence of affective psychoses have been reported: the diagnosis of an affective psychosis is a rarer event in Scandinavian countries and in Germany than in England; and in Germany their incidence is said to vary greatly in different parts of the country. Much of these differences is probably due to varying standards of diagnosis; in many cases admitted to mental hospitals in England as 'recent melancholia', 'recent mania', and 'confusional insanity' the diagnosis is subsequently revised to one of 'primary dementia', 'unsystematized delusional insanity', and so on. Another source of error affecting any attempt at evaluation of these geographical differences is that all these statistics are based on institutional cases, which represent only a proportion of all the people affected. It seems fairly certain that atypical clinical pictures, in which the affective nature of the illness is disguised by non-specific symptoms, are particularly common among the Jewish patients of many countries; this may or may not be correlated with the observation that affective mental illnesses are more frequent in the upper social strata than in the average population. There are many possible interpretations of this last observation.

Seasonc influenc

Manic-depressive illnesses show an especially high incidence in late spring and early summer, a phenomenon which is true of mental illnesses in general; and individual manic-depressives have their own season of the year in which they are especially likely to fall ill (Slater, 1938, a). Further, published observations correlate an increased frequency of suicide with atmospheric disturbances and solar eruptive phenomena, but such observations are not beyond the margin of statistical error. Lange (1928) compared the periodicity of manic-depressive illness with the periodicity of biological functions shown by animals in hibernation, which shows an even closer relationship with seasonal changes.

Central nervous system

Affective mental changes are commonly regarded as functional, and the brain is hardly mentioned as a rule in discussions of the aetiology of affective psychoses. It, however, seems probable, from observations on encephalitis epidemica, that centres in the mesencephalon are responsible for affective regulation, and it is possible that they are concerned in the affective psychoses. Numerous diseases of the central nervous system, e.g. general paralysis, paralysis agitans, and arteriosclerosis of the cerebral arteries, are commonly accompanied by affective symptoms or, in other words, may release an affective psychosis, especially of the depressive kind.

Infectio

Depressive states commonly follow severe infections or other exhausting illnesses. Convalescence after pneumonia and after influenza is very often prolonged by 'neurasthenic' symptoms hardly distinguishable from a mild depressive attack. Hypomanic features at the onset of an infective illness may be shown in restlessness, talkativeness, and flight of ideas, which may be the prodromes of a severe delirium. Puerperal psychoses, in which infection sometimes plays a part, may take the form of an affective illness. In connexion with the last event it might well be considered that the toxin activates the preformed tendency to this type of mental illness; but this interpretation also presents difficulties, for a woman may well have an affective psychosis in one otherwise uncomplicated puerperium and be free from mental symptoms in subsequent or previous child-births.

Psycho-genesis

The importance of emotional experiences as the cause of mental illness is difficult to assess. The relatives of patients, and uninstructed laymen generally, often ascribe the mental break-down to some banal and everyday experience. The specialist, on the other hand, with a bias in favour of a constitutional determination, is sometimes unduly sceptical of the importance of such causes. Many of the 'causes' of break-down given by the relatives of patients are symptoms of the on-coming illness; but depressive illnesses follow emotional shocks with a more than random frequency. Illnesses of this kind at first show an understandable and adequate emotional reaction to the blow of fate which has produced them and from that develop into a picture abnormal both in the intensity and the duration of the affective change. The interpretation of these cases, which are common, is difficult; for not infrequently the subject of such a 'reactive' illness develops on a later occasion a similar psychosis without any preceding affective shock; and a depressing experience may be followed by a hypomanic illness. In sixty-one cases specially investigated from this angle, Aubrey Lewis examined the problem of psychogenesis and concluded that there was no real difference between 'endogenous' and 'reactive' depressions, and that in his cases it was not possible to draw any distinction by symptomatological differences.

3.–PSYCHOPATHOLOGY

ges

A somatic pathology of the affective psychoses has still to be developed, and when finally attained will probably be in the field of the metabolism and the biochemistry of the body and not in that of cerebral lesions. Attempts have been made to account for the physical changes found independently of the psychological changes and to find a common causation for both, but so far without much success. For the most part the physical changes are qualitatively the same as those found to accompany the corresponding emotions in the normal individual. Similar interrelations are found in the psychological symptoms separately considered. Sad people usually tend to be more silent than their wont and to find difficulty in concentrating on indifferent matters. The patient's sadness deepens to a morbid depression, and the difficulty in concentration becomes retardation of all thought and action. Normal cheerfulness usually brings with it greater freedom and ease of speech and movement and a stimulation of all psychological activity; and the

elation to rmal states

manic state shows corresponding symptoms: lack of inhibition, apparent quickness of psychological reaction, distractibility, and flight of ideas. Elation of mood is accompanied by a feeling of general well-being, which in the manic state is manifested as lack of insight; a gloomy mood disposes to preoccupation with gloomy thoughts, and in the depressive are found a hypochondriacal attitude and exaggerated complaints of bodily ill-being. Powerful emotions of any kind militate against normal sleep, and in both types of affective psychosis insomnia is prominent. The total affective state colours not only the individual outlook but also the impression gained of the environment. An effect of this kind can be seen in the preconceptions and the misinterpretations of manics and depressives and even supply a partial interpretation of their delusional ideas.

Mixed forms

There are, however, many exceptions to this general scheme. Depressives are often not noticeably inhibited but restless and talkative and show no sign of retardation. On closer examination the hyperactivity of manic patients is often found to be repetitive and non-productive. Depressive patients may show a complete failure of all insight, deny that they are ill, and hold steadfastly to their ideas of guilt and punishment. Manic patients may feel unwell and complain of their nervousness and excitability. Anxiety in depressives and irritability in both types of patient further complicate the picture; most clinicians agree that pure and uncomplicated manic and depressive states are rare. Kraepelin found it necessary to introduce a third classification of 'mixed forms', in which manic and depressive symptoms are inextricably intertwined. Such mixed forms are not infrequent, especially at the onset of a manic or depressive phase and at approaching recovery. Practically, however, the use of the term should be somewhat restricted and it should not be used to cover every slight deviation from the classical type.

Relation to cyclothymia

'Vital depression

Psychological phenomena in the cyclothymic constitutions have only a limited relevance to those of the graver affective psychoses. Kurt Schneider would distinguish the reactive and psychogenic depressions from the endogenous depressions by the symptoms alone, the depressive affect in the endogenous depressions having a quality of its own, namely, 'vital depression'. The differential diagnosis, however, is one of the greatest difficulty, if it can be made at all, which Lewis and others would doubt.

Psychoanalysis

The contribution of psychoanalysis to the psychopathology of affective psychoses is of dubious value as far as theory is concerned. In papers of Abraham and Freud melancholia receives its place in the scheme of libido development, and its symptoms are derived from loss of the love-object, withdrawal of love into the self, projection, and regression to the oral-sadistic stage. The use of such conceptions is only satisfactory to those who accept the whole of psychoanalytic theory; and even some psychoanalysts, such as Schilder, regard the essential problems of the affective psychoses as still unsolved. On the other hand, psychoanalysis has contributed much to the direct understanding of the symptoms.

Freud pointed out the hidden core of truth contained in the absurd self-reproaches of some depressives; the egoism and aggressiveness of the patient who indulges in every kind of self-accusation and self-depreciation; and the cathartic effect of an attempt at suicide.

4.–CLINICAL PICTURE

(1)—Depression

From the general appearance alone the beginning of a depression is not difficult to recognize. The patient looks tired and self-concerned. Often the sadness of mood is reflected as much in posture and movement as in facial expression. With the appearance of retardation the normal wealth and freedom of expression and gesture diminish. An expression of indifference may disguise the real mood. An 'omega figure' between the eyebrows and Veraguth's folds of the upper lids has been considered characteristic, but 'analysis feature by feature is less informative than a single glance' (Mapother and Lewis). The history of change in the patient's behaviour is characteristic and important; he retires from usual social activities, avoids his friends in the street, and, if forced into company, seems bored and inattentive and takes little interest in topics that usually elicit an active response. Productivity in all spheres diminishes: the sermons of the priest become dull and lifeless; students find themselves bored and disappointed by their teacher; the letters of the business man remain unanswered, even unopened. Work takes longer than formerly and is carried out with greater difficulty. The housewife is never finished in time with her household duties, leaves important things undone, and becomes increasingly negligent of her personal appearance. An atmosphere of listlessness and indolence pervades the whole life of the patient. Conscious of the change in himself, he may strive to hide it from those about him, perhaps with some temporary success. With immense effort he carries out his ordinary duties, but avoids anything new or out of his ordinary routine, and seeks to protect himself from demands that he knows he will not be able to meet. An observant friend or relative may notice the change but mistake it for fatigue or bodily illness. The practitioner may be consulted, who, deceived in his turn, may advise a change of environment, a visit to a spa, a sea cruise, or a life of gaiety and increased social activity, which only accentuate the patient's feeling of insufficiency. Or some bodily symptom, which has been the centre of the patient's increased tendency to self-observation, is made the focus of medical or even surgical attack.

Facies

Behaviour

Decrease in productivity

Suicide

Suicide, or the attempt at it, is often the first alarming symptom of a depressive illness; it is the first and last symptom of many depressive illnesses, occurring when retardation is not evident and the patient's relatives have not noticed that he is ill. In most cases these attempts are desperately earnest, and suicide is by far the greatest danger threatening the patient; twenty-six of the sixty-one cases studied by Lewis attempted suicide, and in twelve of these the attempts were very determined and almost successful. Suicide is often carefully planned, and the means chosen are often selected regardless of the amount of bodily pain and suffering they may cause. The gas oven, drowning, strangulation, shooting, and poisoning are the commonest methods. It is not rare for depressives to kill their relatives, especially their young children, before taking their own lives, to save them, as they believe, from a life of misery and despair.

Presenting symptoms

The patient may come to the practitioner with any of many complaints, the number of which correspond to the manifold ways in which the illness is experienced subjectively. The complaint may be one of sudden and complete loss of interest and enjoyment in usual pursuits; *Mental* of an uncomfortable realization of diminishing quickness of thought and action; of difficulty with customarily easy mental activities; of inability to reach any decision, even in trifling matters; of 'loss of will power'; or of a feeling of incapacity only abolished by taking increasing quantities of alcohol or coffee. Bodily symptoms may be to the fore; *Bodily* e.g. a general feeling of fatigue, of pressure in the head or chest, of heaviness of all the limbs, of sleeplessness, loss of appetite, and constipation. On the basis of these and other unpleasant physical sensations an exaggerated hypochondriasis may develop, the patient remaining *Hypochondriasis* querulously convinced of his constipation or insomnia even after it has been adequately treated, or making some other physical symptom the subject of fresh complaint. This hypochondriasis may be shown also in psychological symptoms, such as exaggerated fears and anxieties, especially the fear of going mad; such symptoms, and also self-reproach and delusional ideas of guilt, may constitute the only complaint made by the patient to the practitioner.

Mood

An initial mood of indifference in depressive states may last for a considerable time but sooner or later is replaced by one of sadness, which may be of any degree from a comparatively slight one to a hopeless despair overwhelming the whole of the mental life. With this there is a diminished capacity for normal affective response to sad as well as happy events, a phenomenon which is merely one aspect of a generalized insufficiency of all mental activities. This insufficiency has been much emphasized by French authors, who have considered it under the name of *asthénie* to be the central symptom of the psychosis. Whatever is experienced seems to be painful. Even enjoyable experiences have this effect, partly by making the patient more acutely aware of his incapacity for normal appreciation, partly because he is at once sensible of any unfortunate aspect they may have; he may in fact show considerable ingenuity in seeing the bad side of everything. Past, present, and future are alike seen through the same dark and gloomy veil; the whole of life seems miserable and agonizing. The depth of the affect cannot easily be measured from its outward expression. The silent shedding of tears may be seen in an otherwise expressionless face; another patient will mock at himself and at his complaints with a grim and sardonic but surprising humour or call himself a fraud or a fool; in another a sudden smile or expression of gaiety will deceive the practitioner about the severity of the underlying emotion.

Anxiety

'Anxiety in some form or other is very often part of the mood, oftener indeed than one would gather from the spontaneous utterances of the patients' (Lange, 1928). Direct questioning will reveal it often enough, and it is largely responsible for the delusional ideas. It may be manifested principally in the form of anxiety attacks, occurring most often at night or in the early morning; they may last for hours, during which the patient clings in panic terror to those around him; or there may be a milder but lasting state of fear, which occupies so much of the affective picture that the presence of an underlying depression is almost a matter of speculation.

Retardation

Retardation, as may clearly be discerned from the descriptions of intelligent patients, is not the same as the absorption of energy and interest by grief. Although some patients, devoid of other spontaneous activity, talk freely about their personal preoccupations, in others the whole mental life shows a uniform retardation, and they may be mistakenly regarded as slothful, stupid, or demented, until with approaching recovery retardation recedes and mental activity is regained. Especially in the higher functions of will, purpose, and decision is the retardation experienced as an almost intolerable burden. The patient feels incapable of initiating or following any complex sequence of thought; the power of imagination fails; ideas and images lose their vividness; memory does not respond promptly to attempts at recollection; the capacity for self-expression diminishes, and speech is an effort. This subjective retardation does not always correspond to that observed objectively and is accentuated for the patient by his general gloomy outlook; he feels his mental faculties are worse than they are and is afraid of progressive deterioration. The observed retardation of movement and speech is often combined with a sense of inner restlessness, of unquiet brooding on perpetually recurring topics of hopelessness and gloom, 'a ceaseless roundabout of painful thought' (Mapother and Lewis). As retardation increases, even comparatively simple actions take unduly long and are performed as though against resistance.

Stupor

Finally, a state of stupor or semi-stupor may be reached, in which all activities, even the simplest, both spontaneous and reactive, show the same phenomenon. Stupor is seldom complete in depressions. The ocular movements usually escape an otherwise universal motor inhibition, and the patients continue to keep themselves clean in defaecation and micturition.

Delusional ideas

Delusional ideas, though not infrequently present, are not essential to a depressive illness. Only a very few patients take an objective attitude to their symptoms, as does the normal man to symptoms of physical illness; almost all have some feelings of guilt, which may be the source of a self-reproach taking many forms; the patient will attribute his failure to insufficient effort, culpable neglect, misuse of former abilities, extravagant living, or masturbation or other sexual practices. The illness is regarded as a punishment for these and many other sins. The whole of the past life is gone over with such misdeeds in view, and a formidable catalogue is compiled and repeated in and out of season as a justification of present misery.

Everything that occurs to the patient is interpreted in the light of the overmastering delusion. He feels himself universally despised and avoided; his sins are bruited abroad and are the subject of the contemptuous conversations of others; doctors and nurses draw aside their clothing to avoid infection as they pass his bed. Delusional fears spring from the breeding-ground of a dominant anxiety; permanent break-down of health, incapacity ever to work again, exclusion from all decent society, cancer, tuberculosis, death, damnation, and hell stand like spectres round the bed. It is hopeless to argue with the patients about these ideas; they can neither be convinced nor comforted, though sometimes they apparently welcome an opposition that permits an endless repetition of their ideas. Ideas of persecution are not based on the primary idea of a hostile environment but are rather secondary to self-humiliation. The patient is watched by detectives, that he may not escape his deserved punishment; the poison in his food is to save him from a public execution; others avoid him to escape infection from his moral decay.

Hallucinations

Hallucinations are rare in typical depressive states. Misinterpretations and illusions in conformity with the psychotic content are common. The distinction, however, is sometimes difficult to draw. It is often not easy to discover what, if any, is the perceptual basis for some of the statements made by patients, e.g. that derisive remarks are made about them by people around, and that their own bodies give off a foul smell. Many of the illusory experiences occur in the hypnogogic state and at night. The patients say that they see grimacing faces at night, or horrible scenes are enacted before their eyes; they hear the rattling of chains or the screams of tortured relations. It is possible that the hypochondriacal complaints have at times an illusional or hallucinatory basis, when, for instance, the complaint is made that inside the body there is but an emptiness, the food is stagnating in the belly, the intestines are rotting, and the bowels are blocked. These symptoms are also related to depersonalization.

Depersonalization

Derealizatio

In depersonalization a feeling of strangeness colours perception and experience of the self, bodily and mental, and of the environment. In so far as the symptom affects the environment, which may be its sole effect, it is spoken of as 'derealization' (Mapother). Depersonalization and derealization are initial symptoms of many different psychological disorders and may sometimes dominate the clinical picture, supply the main content of the patient's ideas and talk, and appear to be the only important symptoms. The world and the people around look strange and unreal; colours are dull, and everything looks far away or is seen as through a mist; the actions of others look unnatural, like those of actors on an invisible stage. The patient's personality seems for him altered and strange. One patient said, 'I used to be Miss A—— H——; I desire most urgently to be identified'; another, 'I feel as if I am dead; I am breathing backwards'. Looking in the mirror, the patient feels as though he were looking at a stranger, though he recognizes every feature; the parts of his body, when he looks at them, seem dead and strange; his actions seem forced and mechanical; his thoughts, feelings, and emotions have for him an altered and disagreeable quality.

Intellectual functions

Intelligence and memory are unimpaired in depressive states, as far as they are accessible to testing. Severe retardation may simulate stupidity or even dementia; but the moment the patient becomes accessible his faculties are found to be intact. Consciousness remains lucid, even in states of stupor and overmastering retardation. This may be discovered by investigation after recovery from such states; and care should be taken not to make tactless or hurtful remarks in front of an apparently completely self-absorbed and inattentive patient.

Insomnia

Disturbance of sleep is the most important of the bodily symptoms. Insomnia sometimes precedes all other psychological symptoms, and restoration of sleep may be the first sign of approaching recovery. The patients have difficulty in getting to sleep, may wake early or several times during the night, and the sleep is unrefreshing and not infrequently disturbed by horrible dreams.

Anorexia

Constipation

Loss of weight

Menstruation

Sexual desire

Anorexia is but one aspect of the inertia of the whole digestive and metabolic system. Food may be resolutely refused for this reason, but other motives, such as desire for death and belief in utter unworthiness, even of being fed and supported by others, not infrequently play a part. Constipation is very common, sometimes fairly severe, and is of great moment to the patients, so much so that slight constitutional depressives are sometimes treated for years for 'nervous indigestion' (Wilmanns). Loss of weight may occur very early and may be out of all proportion to the diminished intake of food. Increase of body-weight is a common herald of recovery. Menstruation may diminish, not infrequently ceases during a depressive phase, and sexual desire and potency are reduced. The general bodily appearance indicates a lowering of all bodily activities. The skin is dry, the vasomotor responses are sluggish, and the patient looks years older than he does when in health.

Daily fluctuation

A prominent and important characteristic of recurrent depressions is the daily fluctuation in mood and total state. Improvement of all symptoms usually occurs towards evening, the retardation and depressive mood showing particularly a change for the better. In the morning, however, the patient wakes direct from sleep into his characteristic sombre mood or is normal for a few minutes, before, as he says, the depression comes down 'like a cloud'.

(2)—Mania

Manic psychoses are rarer than depressions, even in view of the fact that mild manic or hypomanic states are more likely than mild depressions to escape notice. The manic patient neither feels nor looks ill and on examination commonly presents a picture of perfect physical health. The manic attack not infrequently begins with a slight mood of depression, lasting a few days only, and gradually changes to a mood of increasing elation, accompanied with increased activity and restlessness.

Behaviour

After a short sleep the patient rises early to a day of continuous and joyous activity. The housewife has most of her ordinary work done before breakfast and spends the rest of her day in an unnecessary spring-cleaning or in dressing herself up in bright colours, with a plentiful but often inartistic use of cosmetics, and in running round to visit all her friends, regardless of whether they are likely to want to see her or not. The business-man shows unusual enterprise, is full of plans, which, inspired or not, he regards with uncritical optimism, and takes considerable and unjustifiable risks in carrying out his ideas. He is self-assertive, boastful, and easily irritated when others fail to conform with his plans. Nothing is done quickly enough for him; no one can compare with himself in efficiency and success. The past and present he regards with self-satisfaction, the future with radiant self-confidence. He is in an excellent humour with all the world, and indifferent trifles may tickle him to a loud hilarity. Sexual desire and enterprise are increased and in women may be the source of serious trouble and the main reason for seeking the practitioner's advice.

The hyperactivity in manic states is rarely fruitful, but in a favourable combination of circumstances it may lead to real, occasionally to brilliant, success. The chances of success are usually impaired by the lack of sense of proportion and by inability to keep to any fixed purpose. A history of fussy and ill co-ordinated activity, of writing innumerable letters to distant acquaintances or strangers, particularly those in higher walks of life, and of the initiation of proposals of improvement in matters outside the patient's province are typical manifestations of manic behaviour.

Symptoms

Thanks to the feeling of general well-being there are usually no complaints. The patient, however, may often be persuaded to consult a practitioner for increasing sleeplessness and a not infrequent feeling of 'nervousness'. In a more severe state the irritability and distractibility are felt by the patient as unusual, even abnormal, and may lead to a feeling of helplessness, of which advantage should be taken to secure medical advice. But all mild manics and hypomanics fail to show the slightest insight during the episode and very little even afterwards. They find life supremely enjoyable, are convinced of their increased powers and efficiency, never feel tired, and are scornful of the very idea of taking medical advice and utterly opposed to accepting it.

Mood

The mood shows all degrees between an infectious jollity, a sparkling and cloudless hilarity, and wild excitement. Even in the slighter changes the patient, though for a time he may be amusing, even exhilarating, company, is likely to become boring and overbearing. The tendency to domineer and to order others about readily leads to conflicts with the environment. These are not all taken in good part by the patient, who on such occasions easily flies into a rage. These attacks of temper are usually soon over and very seldom leave any ill-feeling with the patient, who after them is his usual sunny self; but this volatility and irritability are prominent symptoms of the psychosis and are not infrequently combined with mischievousness and even aggressiveness. These symptoms may make the treatment in hospital difficult and demand the greatest tact and firmness. The patient takes violent likes and dislikes, passes judgement on others without the least tact, and makes jokes and witticisms which though without ill-will are calculated only to wound. He is as devoid of insight into the minds of others as into his own and at all times expresses his feelings with a childish lack of control. Manics change their medical attendants as quickly as their topics of interest. Generally speaking, the fundamental characteristics of the personality are expressed much more clearly in the manic state than in the depressive (Mayer-Gross), and the clinical state therefore varies much more from case to case. The classical type, with a purely hilarious affect, is rather seldom seen.

Flight of ideas

The stream of thought is more rapid than normal or is at least so experienced by the patient. The output of talk is incessant and shows the characteristic 'flight of ideas', i.e. talk and thought are controlled less by sequence of meaning than by casual associations: similarity of sounds of words, rhyming, punning, and all sorts of word-play, as well as by associations from every sort of object in the environment, which readily engage the patient's distractible attention. The superficial impression of a great range of ideas is fallacious; their range is really very limited. Beneath the apparently illogical flow may be discovered an underlying trend of ideas, influencing the associations, as long as the manic excitement is not too severe. At the height of a severe manic attack the flow of speech breaks down into a scattered sequence of single words, perhaps merely an enumeration of the perceptions of the moment. This is due to the disturbance of attention, which is also shown in the flight of ideas of less severe states. The attention of the manic patient is intense but fleeting; it is occupied completely at any one moment by an object or idea, which, however, is unable to retain it for any space of time. In a few moments he is completely absorbed by something else. This means a very high distractibility. The patient is unable to keep to any topic, to finish any task, even, in the more severe states, to finish a sentence; every object in the environment is no sooner perceived than it exerts, as it were, a forced response, which drives the patient on his headlong path. It is therefore impossible from the usual tests to form any judgement of the preservation of intelligence or memory, which, however, remain intact, as can be shown in less distractible cases.

Distractibility

Delusional ideas

There is no sharp boundary between the natural conceit of the manic and grandiose ideas which may become delusional; but fixed delusions are very uncommon, and what is seen is rather a playful fabrication which is ready to accept any grandiose suggestion offered, gasconades of self-conceit and ideas of persecution developed from the restraints imposed by the environment. The last is responsible for some querulousness, which is almost the rule. Transient hypochondriacal complaints also occur with some frequency.

Confusion

Manic excitement in its most severe form leads to confusion, in which the typical symptoms of mania are obscured. Consciousness, which is clear in the less severe states, becomes clouded, illusions and hallucinations may be observed, and the condition resembles a toxic delirium. These states are seriously debilitating and may endanger life. Sleep is severely disturbed in these graver psychoses, but it is also shortened in the milder forms. Another bodily symptom is the exhaustion which supervenes on months of hyperactivity and reduced sleep. The intake of food may be seriously interfered with, for the manic may not give himself time to eat sufficiently, being constantly diverted to something else. Body-weight, which increases in the milder stages, rapidly drops, and very careful nursing is required. Similar daily fluctuations are seen in manic as in depressive states.

Insomnia

Body-weight

Daily fluctuations

(3)—Involutional Melancholia

With increasing age the comparative frequency of mania drops, whereas that of depression rises. In later life there seems to be a predilection for the depressive type of emotional reaction, as is seen in normal life and in all the psychoses of known aetiology, general paralysis, arteriosclerosis, and senility. Even cases of typical recurrent manic-depressive psychosis tend to depression during the involutional period; and at this time of life a depressive illness attacks many who have never suffered in any similar way before; such an attack may be the only one, or it may be the first of a series of recurrent depressions or the first attack of a relapsing manic-depressive illness. That organic and functional changes associated with the climacteric or involution should precipitate such break-downs can be readily understood, but exactly what endocrine or metabolic alterations are responsible is still unknown.

Symptoms

The symptoms of involutional melancholia differ to some extent from those of depressions occurring in youth and the prime of life, and this has led some authors to classify it as a separate entity; but this artificial distinction seems to be devoid of any aetiological justification. The principal ways in which involutional depressions differ from those of earlier life are as follows: (i) besides the profound depression, anxiety is a conspicuous element of the affective state; (ii) retardation is usually not prominent, and the anxiety is expressed by severe restlessness and agitation; and (iii) there is often a rich development of delusions centering round the patient's feeling of guilt, frequently hypochondriacal and grossly bizarre.

Onset

The onset is usually insidious, with a progressive irritability and peevishness, increasing worry about health, business affairs, or financial circumstances, an increasing restlessness, and apprehensiveness. The expression becomes one of extreme misery; the patient wrings his hands, weeps and moans constantly, and repeats over and over in a monotonous and stereotyped way a phrase or phrases expressive of his misery, abasement, or self-reproach—'Oh God, oh God, what have I done? What have I done? All is lost, all lost, all lost.' In bed his attitude is bowed and often somewhat rigid, but there may be free use of gesture or restless fumbling picking movements of the fingers. He is not lost to his environment but notices it only to interpret it in the light of his preoccupations or delusional ideas. The cries or screams of other patients signify that they are being subjected to torture, for which he is somehow responsible; if another looks at him, it is a look of contempt or pity; the vaguely heard conversation of others is on the subject of his misdeeds. His delusional ideas are legion and tend in their depressive setting to have a touch of the grandiose. His sins are so horrid that he has destroyed the happiness of the whole world; catastrophes and misfortunes that he reads of in the paper and the illnesses of the patients round him are all to be traced to him; to provide him with food they are being starved; nothing will go aright until he is destroyed; a horrible fate awaits him; he is to be tortured, and his body will be torn to pieces, but he will never die. Even so manifold are the hypochondriacal ideas: his bowels are blocked; he has not been able to defaecate for years; his intestines are full of filth, are rotting, have rotted away; he is empty inside, has no body at all, and everything he eats falls into empty space.

Delusional ideas

Hypochondriasis

In spite of these absurd ideas, consciousness is clear, and there is no formal disorder of thought or intellectual defect in cases uncomplicated by organic changes. Nevertheless the refusal of food and the exhaustion due to the continual agitation may reduce the patient to a pitiful state. Constant and devoted nursing is required, not least because of the serious danger of suicide.

Suicide

(4)—Mixed Forms

The typical case of involutional melancholia may be regarded as a mixed psychosis with depressive affect and manic hypermotility. Somewhat similar pictures with a mixture of manic and depressive elements may be seen at other times, especially in transitional periods, when a manic phase is followed by a depression, or vice versa. The clinical picture in such states may offer great diagnostic difficulties and is often mistaken for schizophrenia. These mixed forms, however, are comparatively rare. One of the least uncommon is manic stupor, in which the patient lies quiet, speechless, and inaccessible, but the facial expression is one of elation. Later, after recovery, the patient can report that his mind was filled with a constant turmoil of streaming ideas, which so occupied and filled his consciousness that he was unable to react to anything else.

Manic stupor

(5)—Affective Constitutional Types

(a) Constitutional Depressives

The constitutional depressive differs from the depressive psychotic in degree only. Most of these patients never come to the psychiatrist for treatment; always somewhat lacking in energy and self-confidence, they are yet efficient within their restricted fields and live a quiet and secluded existence but are not unsocial. Indeed their gentle melancholy, their pessimism, which may be enlivened by a quietly ironic humour, may be not without charm. Their interests are restricted, and they may develop minor obsessional traits or hypochondriacal preoccupations. This tendency or more severe fluctuations of mood may bring them to consult a practitioner; but they readily relinquish his assistance and drift back to their home-made remedies and self-devised routine. The type is common but is not easily described, for it is as varied as the normal human personality.

(b) Constitutional Hypomanics

A history of this type of constitution is not infrequent in persons who develop melancholia in middle age. An abundant flow of energy, liveliness, sociability, enthusiasm, and resistance to fatigue are the main characteristics. Such types are common and are often found in positions of importance, where their abundant energy has brought them. But they may have got into difficulties from their unbalanced optimism, made themselves enemies through a streak of ruthlessness, or failed at critical moments through a sudden relapse into a mood of depression and defeatism.

(c) Cyclothymic Constitution

The cyclothymic constitution is subject to alternations of mood from the depressive to the hypomanic and vice versa, these changes taking place almost continuously or with more or less prolonged intervals of normality. In the hypomanic state the patient feels well, but the existence of such states accentuates his feeling of insufficiency and even illness in the depressive phases. At such times he will often seek the advice of his practitioner, complaining of such vague symptoms as headache, *Symptoms* insomnia, lassitude, and indigestion. The removal of septic foci in appendix, teeth, tonsils, or sinuses, a cure at a spa, a course of Weir Mitchell treatment, a sea cruise, hydrotherapy, massage, light and electrical treatment, or psychotherapy will produce a rapid cure, provided that the change to normality or to a hypomanic state is already fated to take place. In typical cases such alternate cycles will last a lifetime. In cyclothymic artists, musicians, and other creative workers the rhythm of the cycles can be read from the dates of the beginning and cessation of productive work.

Relation to psychoses

Though psychologically, constitutionally, and from the hereditary point of view these types of affective constitution are closely related to the psychoses, it does not follow that such constitutionally disposed persons inevitably become psychotic. For the difference between a depressive or hypomanic state which requires institutional treatment and one that does not is a difference of social convenience only.

5.-COURSE AND PROGNOSIS

Though instability of mood is a striking psychological characteristic of childhood, affective psychoses before puberty are extremely rare, if they occur at all; they are seldom seen before the age of 20 years. According to Lange (1928) half the patients have their first illness before the age of 30 years, but one-quarter escape till after 40 years. The expectation of becoming manic-depressive is distributed approximately as follows: at 20 years of age, 2 per cent of the danger is passed; at 30 years, 14 per cent; at 40 years, 33 per cent; at 50 years, 55 per cent; at 60 years, 79 per cent; at 70 years, 96 per cent (Slater, 1938, b).

Periodicity

Although periodicity is an important character of the affective psychoses, many patients have only one attack in their lives. In such cases the illness is nearly always depressive, often severe and of prolonged duration, and often determined by physical illness, e.g. the puerperium, or by overpowering psychological difficulties. Other persons escape with two illnesses, which are then usually in adolescence or youth and middle age. Many patients have repeated illnesses at intervals of 4 to 10 years. In these series every sort of combination can be found: depressive illnesses only; severe depressive illnesses followed by slight hypomanic phases, the existence of which can only be ascertained by specific questioning; alternating severe depressive and manic phases with or without periods of normality; recurrent manics with or without depressive phases; 'mixed forms' alternating with either mania or depression; a single manic or depressive illness in a series of psychoses of complementary colouring; and, rarest of all, true cyclothymia alternating continuously from mania to depression. The first attack is depressive in 70 to 80 per cent of cases.

Duration of attack

The average duration of a single attack of mania or depression is from five to seven months, the duration usually becoming longer with advancing age. Generally speaking, cases with a single severe attack or attacks followed by long intervals of normality have a better outlook than those in which the symptoms are milder but the intervals shorter or in which mild symptoms persist even in the times of comparative normality.

Prognosis

The prognosis of the single attack is better the more purely affective the symptoms. The presence of atypical features, e.g. depersonalization, severe hypochondriasis, and paranoid symptoms, augur a more prolonged course but do not indicate that complete recovery will not occur. Patients with a continuous alternation of hypomanic and depressive phases may only require hospital treatment during their depressions, but many of them end their lives in mental hospitals, having required in advanced age continuous treatment. Manic phases are considered by some (e.g. Stransky) an indication of a less hopeful prognosis for the life as a whole. Relapsing manics frequently require certification, whereas periodic depressives may be treated as voluntary patients or out of mental hospitals altogether. Chronic mania also occurs, this state supervening at the end of a series of illnesses from which there has been recovery and providing a lasting and terminal picture of shallow and monotonous hilarity, querulousness, and irritability.

Chronic mania

The relation between the manic-depressive and the arteriopathic diathesis is of prognostic importance: if signs of vascular disease are present, which is often the case in involutional psychoses, the prognosis is much worse. Signs of intellectual deterioration should be looked for, though they may be difficult to establish on account of the patient's inaccessibility and agitation. If a high, very low, or spontaneously fluctuating blood-pressure or other objective sign of arteriosclerosis is found, the prognosis becomes very doubtful, and progressive mental deterioration may be expected. Even these patients, however, may recover from the incapacitating affective symptoms, but organic changes and any degree of intellectual deterioration found are irrecoverable.

Arteriopathy

Progressive mental deterioration does not result from the manic-depressive psychosis. Though hospital treatment over years may lead to a narrowing of interests, social isolation, and extreme dependence on hospital care, secondary dementia from manic-depressive psychosis does not exist. If dementia occurs it is due to the same causes, e.g. arterial disease and senility, as in persons of normal constitution and differs in no way from the changes seen in them.

Dementia

Patients with affective psychoses die from suicide, from cerebrovascular catastrophe, or from intercurrent disease. The risks of the last, however, are increased in severe depressions and manias. Starvation and hypermotility may bring the patient to such a cachectic state that the expert attention of practitioner and nurses may with difficulty save him from untimely death.

Death

6.–DIAGNOSIS AND DIFFERENTIAL DIAGNOSIS

Affective disorders are often the initial sign of a schizophrenic or an organic psychosis, e.g. general paralysis, arteriosclerosis, and cerebral tumour. 'Nothing in the mental state of such a patient enables one to exclude an organic basis for the illness. . . . The decision must turn on the physical findings' (Mapother and Lewis). If physical findings are negative, the diagnosis may be facilitated by a history of similar previous illnesses. If both manic and depressive illnesses have occurred, the diagnosis of affective psychosis may be regarded as established. Further help may be obtained from a family history of similar psychoses in the nearer relations and from the patient's psychological and somatic constitution. Nevertheless a constitutional cyclothymic may have an affective psychosis precipitated by the organic process involved in general paralysis or on-coming senility.

Diagnosis from physical illness

Though the symptoms of an affective psychosis are easy to recognize after they have fully developed, at the time of their first appearance they may be diffuse and vague. They may take the form of physical symptoms, and the differential diagnosis between a depressive and some form of physical illness may be necessary. The exclusion of physical illness must rest entirely on negative findings in the physical examination.

From psychoneurosis

Many depressions are mistaken for neurasthenia, anxiety state, or some other psychoneurosis. Whether this is a 'mistake' or not depends on the significance attached to the terms 'neurasthenia' and 'anxiety state'. If, as many psychiatrists hold, there is no difference in kind but only one of degree between the clinical states covered by these terms, there is no error of diagnosis; for from the beginning the psychiatrist has kept all possibilities in view, and he will not be in the least surprised when the case that he has labelled 'neurasthenia' develops into a severe agitated involutional melancholia. If, however, a real distinction is held to exist between a true depressive psychosis and neurasthenia or anxiety neurosis, the differential diagnosis must be made with great care.

In milder cases features of the original personality and the psychic content supplied by recent or remote emotional experiences make up so much of the clinical picture that the primary lowering of mood may be missed until prolonged observation has made it unmistakable. Care must be taken not to accept unreservedly the patient's explanations, that, for instance, his 'nervous break-down' is due to his failure in business or to a disappointment in love, when the sequence of events was really the reverse. There can be no direct measure of the relative part played by external and constitutional factors in the development of a state of depression or excitement; nevertheless it is important both from the prognostic and the therapeutic point of view to diagnose between, for example, a constitutional recurrent depressive, a hysterical type of personality suffering from a largely psychogenic depression, and a comparatively normal type of personality in a state of depression reactive to particular external circumstances.

In any particular case probably many factors play a part, and the judgement is often largely quantitative. It must, however, be made; for, if there are important precipitating environmental circumstances, they may require dealing with; the hysterical personality may in given circumstances respond well to psychotherapy, whereas the endogenous depression will remain uninfluenced. Hysterical features derived from the original personality may be engrafted on and almost completely overlie a true endogenous depression, and they may also be released in a more normal type of personality under the influence of organic cerebral changes.

From alcoholism

Severe alcoholic intoxication is sometimes mistaken for a manic state. Since the manic at the beginning of his psychosis is often given to alcoholic over-indulgence, the distinction may be impossible before the patient has returned to sobriety. Hyperkinesis in children suffering from encephalitis epidemica is often mistaken for manic excitement. Specific neurological signs may be absent, but the history usually discloses the real nature of the illness. States of excitement in patients with toxic goitre may show every psychological characteristic of mania or at times closely resemble an agitated depression. Some authors assume an intrinsic connexion between thyrotoxic and affective disorders; but, besides the obvious physical signs, the subjects of thyrotoxic psychoses usually show some dimming of consciousness or at least a fluctuation in its clearness.

From encephalitis epidemica

From toxic goitre

Only in severe manic excitement are clouding of consciousness and confusion observed. Generally speaking, depression and mania occur in a setting of clear consciousness. This serves to differentiate affective disorders from similar psychoses accompanying fever or other physical illness, from post-traumatic confusion, and from epileptic twilight states, in which mood-changes may be prominent.

Consciousness as a diagnostic criterion

The differential diagnosis between an affective psychosis and schizophrenia is important and often difficult. The differentiation is simple in all cases in which schizophrenic thought-disorder, incongruity of affect, and a bizarre quality of the behaviour are easily recognized, however prominent the mood-change may appear. The schizophrenic symptoms, however, may be much more vague. The schizophrenic may complain of increasing shallowness of affect, of a feeling of loss of sympathy, and of depression of spirits, using very similar words and phrases to the depressive; but the setting is different. The schizophrenic lacks the warmth and natural expression of the depressive. The same similarity of symptoms and difference of setting are seen in the schizophrenic complaint of loss of energy and will-power, which may closely resemble the subjective experience of retardation. The distinction here may be impossible, until a short and unexpected outburst of bizarre hyperactivity incompatible with retardation indicates schizophrenia. In general it may be said that the schizophrenic, in contrast to the depressive, shows a withdrawal from reality and a remote absorption in psychotic phantasy, a stiffness of movement, a lack of consistency in expression and emotional attitude, and the primary development of delusions unrelated to the affective background. On the other hand, the occurrence of a single apparently schizophrenic symptom in an affective setting is not of great diagnostic significance, especially in young people. Lange (1922) collected catatonic symptoms in manic-depressives and found them fairly common about the age of 20 years. Cases of mania are seen with catatonic features, in which the outcome is no worse than in the classical types. Very similar hallucinations may be found in depressives and in schizophrenics. The single symptom is less important than the total picture provided by history, constitution, personality, and interaction of personality and symptoms. Schizophrenic disorders are probably commoner than affective

Diagnosis from schizophrenia

Catatonia

Hallucinations

psychoses; probably more mistakes are made in diagnosing schizophrenic psychoses as affective than in the opposite direction; and many practitioners mistakenly believe that schizophrenic psychoses are largely irrecoverable and untreatable, and are thereby led by a therapeutic optimism out of touch with reality to regard any case as affective so long as affective symptoms occur. The differential diagnosis between a schizophrenic and an affective disorder, though often very difficult, is extremely important not merely from the scientific but also from the severely practical view-points of therapy and prognosis. When differential diagnosis seems impossible, it may be remembered that combinations of the two psychoses, though rare, do occur. Such a diagnosis should be made only with great caution and only when there is strong positive evidence on both sides. It is as a rule better to postpone judgement than to make an arbitrary diagnosis without sufficient justification.

7.–TREATMENT

(1)—Prophylactic

Sterilization

Manic-depressive insanity, the central group of the affective psychoses, is in Germany a qualification for compulsory sterilization. The measure is of doubtful value, because 90 per cent of the children of manic-depressives are born before the illness could be diagnosed by an expert (Essen-Möller) and because sterilization of the psychotic members of a tainted family does not prevent inheritance of the disease through other members. The question of marriage and the procreation of children is dealt with in Vol. VIII, p. 560. Personal prophylaxis for persons of bad heredity or showing prominent psychological and somatic signs of constitutional predisposition is even more difficult. There is no evidence that prophylactic psychotherapy has any preventive value. The claim of psychotherapists that they can guard a patient against relapse has not been confirmed by critical observers. The avoidance of unnecessary mental and emotional strains and conflicts seems to be a common-sense precaution, as far as such a counsel of perfection is practicable. Persons with depressive and cyclothymic constitutions should avoid posts involving great personal responsibility and self-reliance.

Marriage and procreation

Prophylactic psychotherapy

Avoidance of strain and conflict

(2)—Symptomatic

(*a*) *Depression*

Suicide

By far the most important therapeutic task is to obviate the suicide of depressives. Since the risk is greatest at the beginning of the illness, before retardation has paralysed the patient's activity and capacity for taking decisions, the responsibility rests largely with the practitioner who sees him first. The necessity for correct diagnosis and impartial judgement is obvious. The practitioner must not only deal with the fixed ideas of biased relations but also often with deception on the part of the patient, who will dissimulate his weariness of life. If he speaks of it openly, this is often taken by the uninstructed as a sign that the danger is not real. This is far from true; even a slight suspicion of suicidal inclination should ensure the patient's removal to a place where he can be kept under observation night and day, unless there are facilities for this at home. The relatives often refuse to realize the amount of risk they are taking and 'may be more difficult to manage than is the patient' (Noyes). There is no generally applicable rule for judging the danger of suicide in an individual case, and even competent experts are liable to make occasional mistakes. An unsuccessful attempt at suicide at the beginning of the illness, on the other hand, facilitates the subsequent management.

Hospital treatment

It is a common mistake to try to cheer up a depressive by sending him on a cruise, making him travel, sending him to a fashionable holiday resort, and forcing social activities on him. The same mistake is made with the hypomanic, to provide him with an outlet for his increased flow of energy. Both states, however, should be treated in a quiet environment with as little distraction as possible, unless of a specifically prescribed kind. The most suitable place is therefore a special hospital, which is often quite unjustifiably feared by the relatives. The early depressive is often easily persuaded to enter the hospital as a voluntary patient and usually adapts himself well to the hospital life and to the treatment in bed, which is of benefit both mentally and physically. The bodily condition must be kept under careful observation, especially when agitation or insufficient feeding has brought it to a low level. Spoon-feeding and feeding by nasal tube are unavoidable in many cases. Insomnia may be treated by the administration of paraldehyde or one of the barbiturates. Anxiety and the inner restlessness so common in involutional melancholia are favourably influenced by tincture of opium, which may be given thrice daily in doses increasing from 3 to 25 minims. There is no danger of addiction, but the bottle should be carefully guarded from the suicidal patient. The constipating effect of opium must be counteracted. As opium so given is not a soporific and may militate against sleep, the last dose should be given before 4 p.m. Small doses of insulin, up to 10 units, have been used to improve the appetite and general bodily condition, but great care must be taken with starving patients.

Rest in bed

Feeding

Insomnia

Tincture of opium

Insulin

Even if apparently completely self-absorbed, the patient is sensitive to tactless handling and will be driven only into deeper depression if he feels he is not under sympathetic care. The amelioration of environmental circumstances which have helped to bring him to his present pass will not necessarily cure him but will help him when recovery begins.

Convalescence

Suicide

With beginning convalescence the risk of suicide once more becomes serious as retardation fades. The patient should not be discharged from hospital until there are grounds for thinking the recovery is permanent; useful assistance in deciding this point and in helping the patient to adapt himself to outside life is provided by short excursions and week-ends at home. Relatives often press for early discharge, even when in early convalescence the risk of suicide is still appreciable; and the hospital psychiatrist may need the assistance of the family practitioner to induce them to take a sensible view.

Occupational therapy

During convalescence in the most severe cases and throughout the illness in the less severe ones occupational therapy may prove very useful, but it should not be forced on the uncooperative patient. To obtain the maximal benefit, it should be given with a due appreciation of the psychiatric state and of the patient's talents, failings, likes, and dislikes and given by someone skilled in its management.

When there is a considerable reactive element in the illness, the mere admission to hospital and release from outside difficulties may produce a surprising change for the better. Preparing such a patient for a return to normal life, finding the right moment for putting him on his feet, and perhaps manipulating the environment that will receive him require a thorough knowledge of the individual and all his circumstances, and subtle psychological handling. It is here that psychotherapy in its widest and best sense plays its most important part.

(*b*) *Mania*

Hospital treatment

The manic patient also requires admission to hospital in most cases and in all severe ones. Although admission often provides increased friction with the environment and even an increase in the excitement, the removal from familiar surroundings is beneficial. The manic patient requires tactful handling not only for his own sake but also for that of the other patients.

Sedatives

Bromides

In the treatment of manics sedatives are important. Bromides are useful, but, to avoid the cumulative effect, the bromide content of the blood should be periodically estimated. Especially in the middle-aged arteriosclerotics and those with damaged kidneys, there is the risk of toxic delirium, a grave complication in a badly nourished or agitated patient. Small doses of soluble barbitone or of phenobarbitone have the same soothing effect without danger of accumulation in the system. As a sleeping-draught paraldehyde is the drug of choice. Prolonged baths, which may be taken continuously up to ten hours a day or even longer, in water maintained constantly at a temperature of 96·6° to 98·6° F. (36° to 37° C.), have a remarkably soothing effect and often help the patient to sleep. They are as useful with the agitated melancholic as with the excited manic.

Barbitone

Paraldehyde

Baths

Psychotherapy

Convalescence

Hypomanics and manics without the slightest insight into their condition are not accessible to psychological treatment; but the transition from hospital to normal life may be considerably eased by the skill of a practitioner gifted with insight and sympathy. In their case also convalescence is often difficult, and return to outside life may precipitate a relapse of the symptoms.

(3)—Specific

There is as yet no specific treatment of the affective psychoses, certainly none based on aetiological principles. Empirical methods of treatment by prolonged narcosis (see Vol. IX, p. 102) or by convulsions produced by cardiazol (p. 313) are claimed to have shortened or even aborted the single attack. The value of the latter is still dubious, and awaits the result of further work.

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II.–PARANOIA AND PARANOID STATES

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1.–DEFINITION

Paranoia

1320.] In paranoia there is an insidious development of a permanent and unshakeable delusional system without any other impairment of mental integrity. As it has proved extremely difficult to find cases that conform strictly to such a definition, nearly all turning out to be schizophrenic, the old word 'paranoia', which had borne various meanings during more than two thousand years' use, has been less used of late, and its place been taken by a more useful vaguer term covering the many conditions that are like paranoia.

Paranoid

The derivative epithet 'paranoid' does not beg any question, as paranoia did, about the existence of a separate disease which it denotes; it is a descriptive, not a diagnostic term. It was first applied to the form of schizophrenia in which delusions are prominent and to the more or less abnormal personality out of which a 'true' paranoia may develop.

Delusions

In the usage of these words 'paranoia' and 'paranoid' the emphasis lay on delusions or the potentiality of delusions; what the delusions were about was of less moment than the fact that they occurred. For this, psychiatric history and psychological hypotheses were responsible. But, as delusions of persecution in one form or another were the most prominent in paranoia, with the decay of formalism in psychiatry emphasis came to be laid on the hatred and resentment implicit in the false judgements which the patient arrived at or manifested in his talk and demeanour. It is now this aspect of a patient's state that chiefly leads to its being called paranoid. A paranoid disorder is therefore essentially a social illness, in which the patient is in an abnormal and unhealthy relationship to others, so that he mistakenly believes them to be interfering with him, ill-disposed, unjust, and disloyal to him. This is not a definition; the word 'paranoid' is necessarily unprecise, as may be seen in the description, which follows, of the somewhat diverse conditions to which it is applied; but false judgements about others, generally in the sense of interference or malevolence, are its centre.

False judgements

There is still confusion in the use of the words 'paranoia', 'paranoiac', 'paranoid', and others related to them, such as 'paraphrenia', because of the flux in psychiatric conceptions and classification. Moreover in different countries the conception, clinical analysis, and nomenclature of the conditions in question have shown differences.

Confusion of terms

A paranoid condition may occur in any of the major psychiatric syndromes: it is therefore proper to speak of a paranoid schizophrenic, a paranoid melancholic, and a paranoid general paralytic or psychopath. Gross paranoid conditions, however, if not due to some bodily disease, are nearly always schizophrenic.

Associated conditions

2.–AETIOLOGY

Studies in the heredity of paranoia show a genetic connexion between it and schizophrenia (see MENTAL DISEASES, HEREDITY, Vol. VIII, p. 559), but the evidence is indirect and leaves the clinical differences unexplained. It is at present a matter of conjecture why some persons are constitutionally prone to become paranoid: according to some authorities it is due to a mixture of affective with schizophrenic features; others ascribe it to the presumptive genetic factors which determine the age at which a schizophrenic predisposition will become manifest; probably in some cases also an unobtrusive attack of schizophrenia in youth has left the patient disposed to delusional illness of this sort.

Heredity

Paranoid disorders are much commoner in the later decades of life, the majority occurring after the age of thirty-five, in spite of the frequency of sensitive personality-disorders and ideas of reference during adolescence. Men are more often affected than women. No innate racial proneness has been demonstrated.

Incidence

Age

Sex

Intelligence is not a primary factor, though, of course, complicated delusional systems are not developed by stupid people. Men of the highest intellectual powers, however, may, like Isaac Newton, have

Intelligence

quite simple delusions, and defectives may experience a vivid, though brief, paranoid hallucinosis or show persistent paranoid delusions. A pyknic habit of body (the John Bull type) is said to be commoner than a leptosome one (weedy and asthenic). Abnormalities of sexual desire and behaviour are common, but they are not limited to one anomaly, such as homosexuality or relative impotence (though these are the commonest), nor has their incidence been shown to be different from that in other psychotic groups. It is understandable that the peculiarly strong opprobrium and shame attaching to sexual abnormality should favour the development of ideas of reference.

Physique

Sexual abnormality

Environment

External factors of a psychological kind often play a large part in the causation, as may be plainly seen in those who are partly shut off from normal human intercourse, e.g. deaf people and long-sentence prisoners, and become paranoid in consequence. It is impossible to describe the environmental influences that can help a paranoid psychosis to develop. They may be individual and extended over a lifetime, or they may be largely a state of society, e.g. when the patient lives in a country where spying, secret police, denunciation, and suspicion are real factors to be reckoned with. It is impossible to tell whether or not a normally constituted person can in certain circumstances become paranoid; the evidence is equivocal. The tendency to ideas of reference which most normal people have at times noticed in themselves and, for example, the success of such an experiment as that which Galton made to induce in himself feelings of being spied upon point in one direction; the fact that the majority of deaf people, prisoners, and those deformed or disfigured do not become paranoid points in the other. The question is further complicated by the occurrence of *folie à deux*, *trois*, or of larger groups, e.g. when the members of a whole community are affected for a time with a paranoid disorder. Such communicated or induced insanity, as it is called, probably rests on the false or incomplete information available to those affected, e.g. of two old ladies living together one may know only what the other tells her, and on their predisposition to such a disorder. Unless the latter requisite has been at hand, the condition is a reactive affair which has no deep roots and clears up quickly, as do the prison psychoses, if the circumstances are changed. A single experience, e.g. a false accusation, may be found to have been the starting-point for paranoid delusions, but the ground will have been tilled for this seed, and subsequent events will have watered it.

Folie à deux

Physical disease

Physical disease may be an indispensable cause of a paranoid illness, e.g. when a long-standing paraphrenia in a myxoedematous woman is cleared up completely by adequate doses of thyroid. It may also play a minor, more or less incidental, part. There are many organic paranoid psychoses on record: in general paralysis of the insane, senile and arteriosclerotic dementia, encephalitis epidemica, cerebral trauma, epilepsy, electrical shock, endocrine disorders, various intoxications, uraemia, and especially alcoholism. Alcoholic paranoia is often the

Alcoholism

sequel to an alcoholic hallucinosis; most of these patients are men of schizoid constitution who have taken to drink and whose psychosis later becomes an evidently schizophrenic one.

3.–PSYCHOPATHOLOGY

As the older term 'monomania' recalls, it used to be thought that there was in paranoia a limited aberration of the intellect. This view cannot be maintained now. Consequently, older interpretations which emphasized the falsity of the patient's judgements and the quality of his logic have been superseded by others which lay weight on the affective and instinctual anomalies in the condition. These have been more fruitful and are indispensable to an approximate understanding of the nature of the paranoid symptoms, but they too suffer from the artificiality of attempts to classify mental activity.

Nature of morbid beliefs

In the milder forms and those in which schizophrenic features are least evident the 'catathymic' nature of the patient's morbid beliefs may be very plain; their content depends on inner dissatisfactions, and the patient's perceptions, memories, and thoughts are distorted or directed in accordance with this trend. His morbid feelings are seldom an abrupt recent development. A disproportion between self-esteem and ambition, on the one hand, and achievement and reputation, on the other; refusal to admit an inferiority; a series of humiliations and rebuffs; persistent but dominating affectivity—these may be often traced through the struggles and evasions of the patient's history from childhood onwards. All schematization of this living sequence is inadequate. In the complicated interplay the sexual factor is often most prominent. The patient's delusions may boldly, if obliquely, set forth his sexual troubles. Thus an alcoholic, already sexually ill-adjusted, develops delusions of jealousy after he has alienated his wife and become almost impotent and without desire.

Sexual factor

Projection

Projection is conspicuous in paranoid conditions. This function, by which subjective happenings are made objective, is a universal and necessary attribute, for without it there would be no 'real' world. But morbid projection is concerned with subjective happenings which are unwelcome and unacknowledged. Inadequacy and self-distrust are then not consciously admitted in their naked form but are projected on to the external world, where they are resented and fought against. It is possible to describe this in more precise psychological terms, but it is to multiply concepts and conjectures unduly to consider, as some do, that paranoid projection is a purposive mechanism of defence and escape worked out by some sapient entity in the mind. The problems raised by paranoid illness, moreover, cover much more than this projection; they touch on the fundamental issues of psychiatry and psychology.

Hypotheses

Minute analysis of the psychopathology of paranoia has been made by the authors and adherents of doctrinal systems which cannot at present be proved. In France it is the conception of mental automatism that has been chiefly used to explain paranoid phenomena; elsewhere the psychoanalytic contribution of Freud to the understanding of projection has led to the study and, occasionally, the acceptance of his interpretation of paranoia in terms of infantile sexuality and, especially, repressed homosexuality. Pavlov and Janet have proffered explanations. None of the very detailed expositions of the psychopathology of paranoid states can be fairly stated concisely, and none has proved substantial enough to be incorporated by general consent into psychiatry.

Since 1889, when Tanzi raised the question, analogies have repeatedly been pointed out between paranoid beliefs and those of so-called primitive people and conclusions about psychopathology drawn from them: these explanations, however, come to grief on the central difference that the people of savage or alien cultures behave and hold the relevant beliefs collectively, i.e. in conformity with the requirements of society, whereas the paranoid individual in his morbid beliefs and attitude stands outside or against collective social influences.

4.–CLINICAL PICTURE

Personality

In the least obvious forms or stages delusions may be entirely absent. The man of paranoid personality is unduly suspicious, self-conscious, and touchy; he is quick to detect or resent anything that may be construed as a slight. He explains his failures by believing that he is not given a fair chance, and that someone 'has a down on him'. He may be self-conscious, disliking to go into any assembly, even a small one, because he feels that everyone is staring at him, probably with animosity or contempt, at any rate disapprovingly; or he asserts himself in season and out of season. Sometimes he reasons with himself and sees how ungrounded are his feelings, but he cannot dispel them. There are two contrasted types: the sensitive and the quarrelsome; the one shrinks from social encounters because they give him such pain; the other is challenging, flares up at every incident that can feed his grievance and often provokes ill-will by assuming it in advance and trying to circumvent or upbraid his supposed enemies. Striking examples of these opposed types—the yielding and the fighting—may be seen in the shy self-tormenting youth who slinks down side streets, feeling that people can tell that he masturbates and despise him accordingly, and, on the other hand, the litigious wrong-headed man who is determined to have his rights and will not be put down. These types are too sharply contrasted to include all the forms of paranoid personality; they are extremes between which lie many grades and combinations, and they may both be manifest in the same patient. It is so sometimes, too, with the advanced delusional forms of the illness; an unhappy driven creature will run from town to town over half England to escape persecution and then, perhaps, will in desperation try to kill the man he holds to blame.

Psychopathic personality and insanity

A sharp line between what may be called normal sensitiveness and psychopathic forms can hardly be drawn; it must be left in each case to experience and common sense to decide in the light of all the circumstances discoverable. A similar distinction becomes a matter of legal importance in more severe cases, and an approximate opinion about it must be reached by making words more rigid than mental phenomena. There is no clear division between psychopathic personality and insanity, and the shading of the one into the other may be very plain in a single life history. This succession is of the essence of 'paranoia'; it may be studied in the two most famous and well documented cases on record: those of Jean-Jacques Rousseau and the school-teacher Wagner.

Paraphrenia

Delusions of reference

The clinical picture of paranoia is by no means uncommon as one stage in a mental illness. Its persistence for years in the course of some cases of schizophrenia led to the special name 'paraphrenia' being given to this group, in which, however, hallucinations usually occur. Trifling or neutral happenings are seized upon by the patient and misinterpreted as having reference to himself: he notices meaning gestures, insults, and surveillance; people 'cut' him, shun him, and he must put up with sneers, disloyalty, and slander. When he is away from home, his room is searched or his wife seduced. People try to poison him or make him diseased. Powerful or mysterious forces are at work against him; he sees through their tricks and shams. Even a long catalogue of such symptoms would give little notion of the various beliefs that these patients may hold; they depend so much on the individual and his milieu; they may be fantastic or probable, very complicated or very simple, inculpating intimates or complete strangers. It may be the patient's liberty, morals, sanity, reputation, family, economic position, health, or life that he believes threatened. At an early stage of his illness he may even say that he welcomes the interference; he knows that it is all being done for his good.

Delusions of grandeur

Ideas of grandeur are not uncommon. The patient may believe that he has been picked out for a great destiny, to redeem his people, to found a religion, or to start a new epoch in science. He maintains that he is of high birth. He is an inventor, perhaps, and finds that only the malice of enemies stands between him and fame or a great service to humanity. A patient may be convinced that such and such a woman—a girl over the way, an actress, a queen—loves him and rebuffs his constant attentions only because people come between them.

Delusions of jealousy

Delusions of jealousy are relatively common and serious. The patient thinks his wife ogles men in the street, she is promiscuous, or she plays fast and loose with some friend. Strindberg is a famous example of this in a schizophrenic. In paranoid delusions in general, sexual topics are common.

The more plainly schizophrenic the illness, the less likely is there to be a complicated, intrinsically plausible, delusional system. Hallucinations, hypochondriacal symptoms, and primary thought-disorder are then associated with far-fetched notions: the patient believes his mind is controlled, his thoughts are being read or filched from him, evil pictures and words are forced on his attention, queer rays play upon him, gases are pumped into his room, and he is interfered with in unheard-of ways. The varieties 'paraphrenia systematica', 'paraphrenia confabulatoria', 'paraphrenia expansiva', 'paraphrenia phantastica', and 'dementia paranoides gravis' and 'mitis' represent an unsuccessful effort to systematize the rich confusion of these paranoid schizophrenic symptoms.

Involutional paranoid state

An involutional paranoid condition can occur, mostly in lonely women between 40 and 55 years of age, who believe themselves under some malign influence; auditory hallucinations may seem to confirm this and, like the delusions as a whole, often have a sexual complexion. Much the same picture may occur in senile patients, more or less complicated by confusion or dementia (see p. 346). In these patients their delusions are fostered by their forgetfulness; they mislay their property, for instance, and then accuse others of having stolen it or played tricks on them; they may barricade themselves in their houses.

Melancholia

Many melancholic patients have ideas of reference in keeping with their self-reproach. They believe themselves to be shunned and despised because of their wrong-doing, but they do not, as a rule, resent this treatment and are in this respect not properly to be called paranoid.

Mania

Manic patients may loudly profess to believe that they are persecuted; sometimes this arises because they are so assertive and interfering, wanting more than they can have, and are unwilling to admit themselves in the wrong when they quarrel, but it cannot always be so explained; their mis-statements may be circumstantial and persistent. Hypomanic patients may be mildly but constantly paranoid.

Obsessions

Although in severe obsessional conditions verging on schizophrenia the compulsion the patient feels may at times be objectified, this is rare—extraordinarily rare, considering how close the two conditions apparently are psychopathologically.

Hysteria

Hysterics may show a paranoid attitude; it is commonest in those who have unsatisfied insurance or pension claims.

5.–DIAGNOSIS

The difficulty lies less in judging than in collecting the data. 'Taking the case' may call for the utmost skill and finesse. Without some foreknowledge of the patient's delusions the most expert psychiatrist may talk to him for hours without finding out what is morbid in his mind. The patient may talk well on all manner of topics and steer adroitly away from his delusions or deny them flatly. It may be necessary to check his statements minutely against those of others before concluding whether they are delusions, and, even if his beliefs are false, it must be considered whether he had adequate opportunity for recognizing their falsity. In many cases it is perfectly plain that a man has a paranoid insanity. But diagnosis must be more than a recognition of this; it is necessary to see what the major illness is, e.g. schizophrenia or organic disease, and to compare his psychosis with his upbringing and environment. What is obviously true of time and place is true of social groups, i.e. that tolerably normal, because generally held, false beliefs in one set of circumstances are delusions in another. Thus a patient may talk of the power and malevolence of witches, demons, Jews, or Freemasons, yet his beliefs, absurd though they are, cannot be regarded as paranoid delusions until his cultural background has been surveyed. Moreover, understanding of the case demands full inquiry into the patient's history.

Diagnosis, in the strict sense, does not turn on the issue of paranoid or not and is therefore discussed elsewhere (see pp. 267, 302, 332, and 342).

6.–COURSE AND PROGNOSIS

The social aspect is mainly considered in this article; the other aspects are dealt with under the appropriate disorders. Of the paranoid cases, without obvious schizophrenic or other admixture, only a minority, about a quarter, remain steadily in need of institutional care; some never need it and may never come under the care of a medical attendant. The prognosis is not nearly so bad as was formerly thought; the delusions, once formed, usually persist, either unchanged or with a different content, but do not interfere much with ordinary life. Apart from these rare cases, there is every kind of course in paranoid conditions: a few have brief recurrent episodes, others flare up in middle life, perhaps in association with an attack of depression (e.g. Isaac Newton), and then it all subsides, leaving behind nothing graver than a touchy suspiciousness and lessened initiative; others, much more numerous, progress slowly towards a deteriorating schizophrenia. But in none of them can the social danger be determined by the diagnosis; it needs close individual study of his character and psychosis to judge whether a deluded man will try to injure or kill his supposed persecutor. Threats must be taken seriously: the position is much like that with threatened suicide (see p. 274). It is true that the number of paranoid homicides is not great, but many of them have been preventable. Even when there is no danger of homicide or deliberate assault, hospital treatment may be required on social grounds, because the patient is likely to get himself into trouble by hitting unoffending passers-by, slandering his neighbours, or breaking the windows of a Ministry. Patients who are constantly going to the police station to ask for protection against their enemies and fail to 'get satisfaction' will sometimes take the law into their own hands. The responsibility of the medical attendant is very heavy when a patient has threatened or hinted at homicide. After improvement and discharge from hospital there may be a recrudescence of the delusions and hatred; parole and release

Hospital treatment

therefore call for the utmost caution in cases in which an act of violence has seemed likely; this is especially true of patients with delusions of jealousy; they may murder their wives when they come back to live with them.

Alcoholism

Alcoholics present a difficult problem, because they may become free from symptoms in a mental hospital, though still resentful towards their wives for having concurred in their certification, but, when they get home again and start drinking, the delusions return, and great harm may result. General paralytics, likewise, after malarial or other treatment, may remain dangerously paranoid.

General paralysis

In ordinary life

When the paranoid patient continues in ordinary life, i.e. outside a hospital, his subsequent history may depend much on his environment; if he becomes enmeshed in endless lawsuits or is otherwise thrown into situations which will stir up his morbid tendencies, it will go ill with him. Gross sexual offences, e.g. rape, indecent assault, and homosexual seduction, seldom occur as crimes of paranoids. Of the other social and forensic aspects testamentary capacity is the most important; paranoid delusions may invalidate the whole of a will or those clauses in it which have evidently been influenced by the delusions.

7.–TREATMENT

There is no method of treatment specially appropriate to these cases; the usual methods and rules apply and may be found under the relevant heading elsewhere (see PSYCHOPATHIC PERSONALITY, p. 264).

Attitude of practitioner

It is even more important in these than in other mentally disordered patients for the practitioner to maintain the attitude of an impartial and detached, though interested, listener who wants to understand their point of view and help them as far as he can; he must avoid argument with them, on the one hand, or, on the other, seeming to corroborate their delusions by agreeing with them: nor should they be misled by promises that cannot be kept.

In considering what treatment is practicable, the social as well as the more obviously medical possibilities are important. Even in a long-standing sensitive or quarrelsome paranoid with good preservation of manifest intelligence and behaviour some improvement may be obtained by judicious treatment, social and other, heavy though the odds against the patient often are. On the other hand, it is extremely rash to suppose that the patient's lucidity, understanding, and expressed desire for treatment are good warranty, as an eager psychotherapist might assume.

Social problems

Social problems, such as have been mentioned on page 299, often complicate treatment, and certification may be urgent and imperative when the patient first comes under a practitioner's notice. It is necessary to balance the interests of the patient against those of others and to avoid underestimation of the latter.

When there are definite delusions and ideas of reference, psychotherapy of any detailed sort is unjustifiable, save in a mental hospital or under special conditions by the very expert. Psychoanalysis does not benefit these patients. Transient or non-delusional paranoid reactions demand very careful and practised handling; it is unfortunately easy to aggravate them. *Psychotherapy*

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III.—SCHIZOPHRENIA

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1.—DEFINITION AND NOMENCLATURE

1321.] The definition of schizophrenia is very difficult and must be in symptomatic terms, because neither the aetiology, nor the morbid anatomy (if any), nor the pathophysiology (if any is characteristic), nor the psychopathological basis (if any) is settled. The symptoms are extremely varied; many that are characteristic of the group as a whole are lacking in individual cases.

In the meantime schizophrenia can be regarded as a collective term for a number of mental disorders originating usually in adolescence or early adult life, sometimes as early as childhood and as late as middle life; characterized usually by slow, but occasionally by fairly sudden, onset; by very varied symptoms, of which the main features are a lack of connexion with or a withdrawal of interest from the external world, with consequent oddity of behaviour; by a mental disharmony, so that thought and feeling are no longer related to one another in a congruous way; by unusual experiences, such as phantastic auditory and, less often, visual hallucinations; by feelings of being controlled in thought or action; and by a kind of indistinctness of the personality, so that the patient feels himself merged into or identified with external objects or individuals. The course is usually one of increasing mental deterioration although without intellectual impairment. In a minority of cases recovery to more or less normality does occur.

Historical nomenclature

It is hardly possible to get the proper meaning of any word without knowing its history; this is especially true of the term 'schizophrenia'. I am not referring to its linguistic roots in σχίζω and φρήν but to its history and antecedents in scientific nomenclature. Till 1894 'hebephrenia', a deteriorating disorder related to puberty and adolescence, was distinguished from 'catatonia' and 'dementia paranoides', which were till then regarded as separate entities; but in that year Kraepelin assembled them all together as aspects of one dementing process, and in 1896 he included 'dementia praecox' under the caption of 'metabolic disorders' together with general paralysis and myxoedema—an assortment that now seems strange. Finally, in 1898 dementia praecox was described as a specific entity with a hypothetical specific cause (metabolic in some sense yet unknown), a characteristic progressive course, and a not quite invariable termination in dementia. The reasons for the gradual substitution of Bleuler's term 'schizophrenia' for the older dementia praecox are as follows: (i) many patients with dementia praecox do not progress steadily to dementia but recover more or less completely; and (ii) in whatever sense the word 'praecox' is taken it can be wrong; neither does dementia necessarily occur rapidly and therefore early in illness, nor is this illness confined to adolescents.

Clinical conceptions

The clinical conception of schizophrenia has tended gradually to include more and more, so that the term in some quarters now covers nearly every psychosis which is not clearly exogenous and cannot be included in that other comprehensive clinical category, the manic-depressive psychoses. Moreover individual symptoms, even when occurring in settings not clearly schizophrenic, are frequently called 'schizophrenic' in everyday clinical usage. Consequently a certain looseness has crept in, of which it is necessary to beware.

Schizoid personality

The conceptions of schizophrenia and manic-depressive psychosis have introduced terminological complications in other directions. Observation of the antecedents of these mental disorders reveals certain mental differences between candidates for each type of illness; and the scope of the name schizophrenia has been extended to designate the type of personality predisposed to it as 'schizoid'. This also has undergone a diffuse generalization, at the hands of Bleuler, who now 'sees schizoid traits in everybody' (Meyer). 'The term schizoid designates a type of mental nature and reaction which is more or less present in everybody, and its morbid exaggeration constitutes schizophrenia' (Meyer).

2.–AETIOLOGY

Causation

Heredity

Little is certainly known, and the causation in the precise sense still eludes us. Heredity is undoubtedly a factor (see Vol. VIII, p. 556), but some observers have postulated a schizophrenic type of illness without a hereditary factor (e.g. Manfred Bleuler), which is said to occur in people of different physique and temperament from the usual schizophrenics.

Age of onset

The commonest age of onset is between 15 and 25 years, but cases as early as the age of childhood and as late as later middle life or even early old age have been described.

Schizoid personality

One of the outstanding facts, although the exact significance of it is not clear, is the prevalence of traits of personality of the so-called shut-in or schizoid type. Many patients developing schizophrenia have been shy, seclusive, oversensitive, diffident, and egocentric. Other qualities have been described: obstinacy from an early age, inability to stand criticism, extreme 'goodness' and perfectionism, and excessive day-dreaming. It has been suggested by Adolf Meyer that the disease is usually nothing more than the result of the accumulation of traits of this kind, the inevitable and cumulative result of persistent maladjustment with increasing frustration and dissatisfaction and consequent further withdrawal into the self. The fact that sometimes the disease may nevertheless appear to be sudden in onset is explained by Meyer as analogous to the rupture of compensation which occurs in heart disease. This hypothesis of 'habit deterioration' has fascinated many; but there is nevertheless an impression of discontinuity between the shut-in personality and the disease, which suggests that some other factor is concerned, possibly a kind of inherited pattern of brain reaction which may be elicited by any physical or mental stress. Certainly a schizophrenic symptom-complex may appear not only to grow up on the soil of a schizoid personality but to be produced in otherwise not obviously schizoid personalities by any physical or mental stress, and when the stress is withdrawn the reaction may subside, i.e. it is not necessarily a self-perpetuating process.

'Habit deterioration' hypothesis

Physique

Schizophrenia is relatively much commoner in people of asthenic or athletic physique (the 'Uncle Sam' type) than it is in those of pyknic physique (the 'John Bull' type). This fact was first shown by Kretschmer but not in any precise way; his observations appear to be confirmed by Wertheimer and Hesketh who used a definite index based on physical measurements.

No one, however, can fail to be impressed by the physical appearance of a large number of deteriorating schizophrenic patients, especially their juvenile immature physique. The secondary sexual characteristics are inadequately developed more often than in the general population, and in general the patients look younger than their years, and their general physique is seldom well developed. Dysplastic types are specially frequent among them.

Basal metabolic rate

Physiological and metabolic studies have been singularly unfruitful, the results being without certain significance. On the whole the basal metabolic rate is lower than the average, which has been held to indicate that there is a general 'suboxidation' in schizophrenics. Clinically this is perhaps supported by the improvement which follows exercises in deep breathing and general physical reconditioning; and by the fact that in some catatonic stupors at least short temporary improvements follow the inhalation of an atmosphere containing a high proportion of carbon dioxide; but a similar improvement follows the intravenous injection of sodium amytal, so that something different from simple oxidation is involved in such a temporary change.

Psychoanalysis has provided speculative descriptions of what is supposed to happen psychologically in schizophrenic illness, but the hypotheses have a descriptive rather than a causal significance and are without accepted therapeutic confirmation.

Many histo-pathological studies have lent colour to the view that some kind of cortical lesion is the basis for this type of illness; but the best studies of this kind contradict this (Dunlap). Much has been made of Mott's statements that he found atrophic or regressive changes in the endocrine glands in general; his work, however, has not been confirmed but on the whole so far confuted.

Any kind of physical or mental stress may precipitate a schizophrenic illness in a predisposed person; but the predisposition seems all important in such cases. The only noxa which is known to be capable of producing experimentally some schizophrenic-looking symptoms in persons apparently not predisposed is mescaline, the alkaloid of the Mexican drug of addiction mescal buttons or *peyotl.*

3.–CLINICAL PICTURE

The most characteristic features are usually described as a gradual onset, a disharmony between mood and thought-content, oddity of behaviour, incoherence of thought, ill-systematized delusions, feelings of influence, and a gradual deterioration ending in more or less dementia. These signs characterize the institutionalized patient well enough; but if they are used as infallible touchstones, many cases, and not only early ones, would be missed. Most cases show a gradual onset; but with acute infections, such as influenza, some observers have reported a schizophrenic syndrome without any discoverable antecedents. Many cases, not post-infectious, certainly have the appearance of suddenness; but this often is contradicted on closer investigation.

Onset

The more carefully a history of an acute onset is scrutinized, the more likely it is to appear that prodromal symptoms had been in existence for a considerable time before; and the instances in which the onset can be truly said to be sudden are comparatively few. More often a hitherto quiet, docile adolescent becomes progressively more retiring and shy, more dreamy and preoccupied. He may be found gazing into space or at the ground; if roused he will answer correctly enough; till one day he says or does something eccentric, not enough in itself to cause alarm. A phrase or two in a letter may strike the recipient as peculiar; or a letter may be written to someone, usually someone of importance, whom the individual has never met. In the less unaggressive type of individual, the first clinical sign of abnormality may be a sudden departure from his usual habits, e.g. some journey not afterwards explained, or the explanation has a ring of oddity about it; or the patient may suddenly assault someone who has no association with him. In cases with a stormy onset the patient may pass from outward normality to most acute disorder of behaviour within a few days.

Mental symptoms and signs

It is on the points of apathy and the alleged 'intrapsychic ataxy' of mind and thought that the now classical definition can be most seriously questioned; and it is serious, since these are the fundamental parts of the definition and are supposed to refer to the fundamental 'structure' of schizophrenia. The early schizophrenic is often apathetic in the sense of disregarding the more common-sense aspects of his environment; but he is often keenly aware of the topics of his own preoccupation and of aspects of his surroundings not coloured by his more psychotic projections. Disharmony of mood and thought is often not demonstrable in early cases; and even in the long-standing case the disharmony may be apparent and not real (Sullivan). If the significance of the thought-content is known, the accompanying mood becomes appropriate and comprehensible. Yet a disorder of affect in schizophrenia is seen in the advanced case plainly enough as a shallowness or even a complete lack of affect. It is as if something in the personal equipment had been lost. Even in the early case there is a defect which might be called a thinness of affect. If the patient is elated, the elation is a poor thing, not at all infectious, and more than a little spurious-looking. One feels sorry for a man who cannot be more genuinely and robustly happy than that. If he is depressed, it is not a sweeping depression. No one would choose the patient as a model of gloom. So this thinness, or shallowness, or, ultimately, failure of affect can be regarded as more constantly characteristic and probably more truly a matter of observation than the discrepancy or disharmony or ataxy which is conventionally regarded as the central characteristic.

The apparent oddity of behaviour is often explicable on similar grounds. If the accompanying mental content is known, the reason for this behaviour becomes clear; but it is not always possible to discover the content; and the behaviour would often appear odd from any aspect. The usual account of this state of affairs is that the mental content behind the behaviour is unconscious; but that is begging the question.

Apparent preoccupation

A truer description of a schizophrenic patient, especially in the early stages, would include apparent preoccupation, producing neglect of the aspects of the surroundings normally considered important; a 'thinness' or comparative poverty of affect, or with affective outbursts, of the erotic or guilt-hatred-envy group; an appearance of strangeness, of difference, or 'queerness' (dependent partly on the idiosyncratic nature of the thought-content if not communicated; partly on the patient's inability to allow himself to disengage himself from his preoccupations or to put himself *en rapport*); apparent oddity of behaviour, from mere stiffness of deportment to bizarre actions; and a thought-content either vague or idiosyncratic, with beliefs, delusions, and hallucinations unacceptable to anyone else, and no insight for the latter, although perhaps for the fact of being ill.

'This peculiar and fundamental want of any strong feeling of the impressions of life, with unimpaired ability to understand and to remember, is really the diagnostic symptom of the diseases we have before us' (Kraepelin). This affective weakness is, according to Kraepelin, the primary defect; the other fundamental defect is the disturbance of the will. Bleuler, on the other hand, regarded the disarrangement of association, emotional and intellectual, as the fundamental factor. Affective dementia is characteristic only of the more severe cases. All the other principal disturbances of activity and attention can be deduced, according to Bleuler, from disarrangement of association. Hallucinations and delusions, symptoms such as depersonalization, and disturbances of handwriting should then be regarded as merely accessory symptoms. The form and content of thought are so characteristic that, arising in a setting of clear consciousness, they are often virtually diagnostic. A sample of the verbal or written productions of a schizophrenic is sufficient to enable a diagnosis to be made with a high degree of probability.

The form is one of more or less incoherence, but with associative connexions determined either entirely superficially or by the curiously symbolic habit of the schizophrenic's thought. Jung first showed that much of the apparent incoherence depended on this kind of symbolic connexion. For example, his patient, when she asserted 'I am Switzerland', meant 'Switzerland is free; no one can rob Switzerland of her freedom. The patient does not belong to the asylum; she would be free like Switzerland; hence she is Switzerland' (Jung).

Telegrammatic utterance

The patient's utterance may have even a telegrammatic form, the patient dispensing with ordinary rules of syntax. This may perhaps be due to his lack of any feeling of need to communicate his thoughts, because of extreme self-centredness or 'autism' or 'introversion', as it is variously called.

'Autism'

A similar explanation may be given for the neologisms scattered here and there in the utterances of schizophrenics. They are words, as it were, of the patient's own invention, reminiscent sometimes of the portmanteau words of ordinary life.

The following is a typical example of schizophrenic utterance: 'Oh, I said yes, yes, yes. I'd go off to sleep immediately afterwards. I said, I knew quite well. Nothing, I said. I forget all that I saw next. The next thing was—eh? The poor man's mad. They'll be chopping off our heads next, and calendars tied with blue ribbons. Oh, dear God. Contrary Mary again. What period—that's right. I don't like acting the goat at all. A cream-sponge sandwich. My memory is so slow, that all I'm sure. It was caramels then and fruit cakes. Well, well, I said, I can't help it—I don't want to help it, and well, I don't care. Contrary Mary again, and says—Nurse Grant—dogs barking. What's the matter with me anyway? I'm so terribly stupid. I'm fed-up with this place—that's all. Sago pudding. She looks pale and tired often, but not—I know that' (Henderson and Gillespie).

Accessory symptoms

The 'accessory' symptoms are mainly as follows: hallucinations, visual or more often auditory, and delusions, ill-systematized and often fleeting; peculiar bodily sensations, associated with hypochondriacal delusions and including odd feelings referred to the head (not simply headaches); complaints of interference with thought, the patient feeling that his thoughts are controlled or influenced; and complaint of interference with his movements and behaviour, which is inevitably disturbed, in association with such thinking and feeling.

Intra-psychic ataxy

Comparative inactivity is usually associated with preoccupation. The patient often smiles or weeps to himself, but without apparent reference to the current of any spoken thought (intra-psychic ataxy). But sometimes there is great restlessness for a time, or, especially in the so-called catatonic types, impulsive activity, i.e. sudden and inexplicable action. Sometimes this is the result of paranoid ideas, the patient responding either by flight or attack to notions that he is being influenced in some way, or reacting by impulsive self-damage to masochistic or suicidal thoughts. The day-dreaming, which is often of self-importance, may be accompanied by appropriate dressing up and other forms of self-display, or in other instances with strange mannerisms and attitudes symbolizing certain trends of thought.

Symptom-groups

According to the preponderating symptoms various names have been attached to various symptomatic manifestations, and an attempt has been made to group certain sets of symptoms together as occurring more frequently than others. The commonest group-names are the simple, hebephrenic, paranoid, and catatonic forms. The simple form includes those cases which show only the fundamental loss of affect and energy and little else. The hebephrenic group shows mainly delusions and hallucinations, silly laughter, self-absorption, and some impulsive behaviour, with a rapid deterioration into a vegetative state of inactivity. In the paranoid group slightly better organized delusions, sometimes with a good deal of anxiety, culminating in attacks of panic, are the most prominent feature; whereas the catatonic forms show especially episodes of excitement and stupor of varying degrees of intensity, and with loss of the ordinary defensive reactions (i.e. lack of response to threats of actual physical danger), with negativism (resistance to command or passive movement) or its opposite, automatic obedience. The stupor alternates sometimes with periods of extreme excitement, characterized by ceaseless and impulsive activity, with much

Simple

Hebephrenic

Paranoid

Catatonic

incoherent talk in which the same topic is often repeated, and with resistance to any kind of care.

4.–COURSE AND PROGNOSIS

Dementia

Social recovery

Complete recovery

The subsequent course varies; more usually after a period of more or less obvious abnormality the patient settles down into apathy, taking little interest in the outside world, yet automatically registering much that goes on round him. He deteriorates slowly in speech and behaviour, becoming more incoherent and phantastic in the one and more and more stereotyped in the other. The ultimate fate of the most usual kind is a vegetative useless existence of dementia, in which it appears as if thoughts were no longer taking definite shape and nothing were capable of stimulating the patient to emotional activity or interest. This, or something like it, is the common course; but the process in individual cases may be arrested at almost any stage; the term 'social recovery' is conveniently used for the best of these stages short of complete recovery and designates a state in which the patient retains some of his abnormal ways of thinking but is able to adapt himself well enough to live outside an institution. Some patients, usually those with a more rapid and stormy onset, especially if precipitated by some obvious and considerable stress of external origin, recover completely, usually within the first year, and seldom after that.

Spontaneous recovery rate

The 'spontaneous' recovery rate, i.e. in those patients not treated by the recently introduced methods now classified as specific, is not easy to ascertain, since the statistics deal mainly with institutional cases; and some patients with a short or milder illness never reach the mental hospital but are otherwise dealt with. Furthermore, diagnostic criteria vary greatly. A very liberal estimate, however, places the spontaneous recovery rate at 30 per cent. Some observers, for adolescents between 14 and 17 years, have placed it as high as 50 per cent, but this is very different from the usual impression. The most favourable form is the catatonic. It is generally agreed that the more sudden the onset, the greater the previous external stress, and the more satisfactory the previous personality, the better the prognosis. A gradual onset, a feeble personality, and a very morbid heredity are considered unfavourable.

5.–DIFFERENTIAL DIAGNOSIS

In the earliest phase of schizophrenic excitement a differential diagnosis from manic-depressive conditions and from acute organic reactions (delirious or confused states) is often difficult; the knowledge that a sibling has suffered from an undoubtedly schizophrenic illness is of value both diagnostically and prognostically. The manic type of excitement gives the impression of more genuine elation, as a rule, and the patient's utterance shows a wider range, and is apt to show a real, if superficially associative, connexion. Distractibility is more marked in the manic, impulsive behaviour is more characteristic of the schizophrenic, excitement. For the problem of differentiation from cases of infective or toxic origin see page 328.

6.–TREATMENT

(1)—General

Until recent years there was no specific treatment of schizophrenia. But to speak of 'spontaneous' recovery alone does less than justice to the measures taken to protect, and when possible to stimulate, schizophrenic patients in mental hospitals. Without medical and nursing care many would die of self-destruction, either from impulsive violence or from persistent neglect of the ordinary means of self-preservation and of the calls of nature for nourishment and excretion.

In mental hospitals

It is probable also that many patients who would otherwise deteriorate rapidly are more or less arrested in their progress and are reclaimed to some extent by occupational therapy, which is now developed in the best mental hospitals far beyond the old methods of employing the patient in the garden or in the kitchen. With the aid of special occupational teachers the staff in general tries to fit the occupation to the patient, and all kinds of work are available.

Occupational therapy

Whatever may ultimately come of the methods of treatment shortly to be described for which specificity is claimed, the practitioner must first decide whether or not to place the patient in a mental hospital. There is no doubt that in most cases this is the best course in the beginning—a special hospital can safeguard the patient and at the same time give him the necessary stimulation of interest. Parents often for sentimental reasons want to avoid the special clinic or hospital, when it is the only safe step to take. For the patient who has been ill for some time, without showing any outspoken signs, and for whom a sympathetic and understanding environment can be provided outside of hospital, full advantage should be taken of these possibilities, and hospital care can often be avoided. Provided that there is no danger from impulsive or erratic behaviour, the best environment is that in which most individual attention (not molly-coddling, however, but interesting and stimulating) can be given.

Home treatment

The patient may go to a mental hospital by any one of the legalized methods of procedure (see Vol. VIII, p. 565). Symptomatic treatment in hospital depends on the state of the patient; insomnia and refusal of food must be combated by the usual methods. Tube feeding may have to be resorted to for a time, and every effort must be made to see that enough fluid and food are taken, the diet being well mixed. One of the advantages of hospital over private care is that it is usually possible to manage with less sedative. Too often entry is delayed and the patient reaches hospital, if he has had acute symptoms, in a state of dehydration, acidosis from insufficient nourishment, and mild toxaemia from excessive dosage with sedatives. Often also he arrives at hospital with an overloaded bowel. Everything must be done to make the patient as physically fit as possible. There is, however, no really sound evidence that focal sepsis has anything to do with the great majority of cases.

Sometimes self-injury is a dominant consideration in the more acutely ill cases; behaviour is often incalculable, and attempts at self-destruction or attacks on others are impulsive.

(2)—Specific

(*a*) *Insulin Shock Therapy*

This treatment consists in the repeated induction of hypoglycaemia. The method was introduced entirely empirically by Sakel in 1933, the rationale being still unknown.

Phase I

It is customary to describe four phases of the treatment. In Phase I the patient is given a dose of insulin each morning, having fasted since 7.30 the night before. An intramuscular injection of 20 units, or less in the case of debilitated patients, is gradually increased daily by 5 to 10 units till the initial coma dose, which may be as low as 8 units (Frostig) or as high as 640 units (James, personal communication), is reached. During this phase euphoria is first produced, followed by excitement, which may be very wild and require special bedding arrangements to prevent injury, and then by somnolence.

Dosage

Phase II

Phase II is considered to date from the appearance of the first coma during which salivation is the prominent feature. Extensor plantar responses can be obtained; tonus, usually in flexion, appears and is followed by hypotonus and disappearance of the reflexes, including the corneal and plantar reflexes. Ultimately hypertonus may appear, the condition resembling that of a decerebrate animal, with the pupils dilated and failing to react to light. This stage is dangerous and is interrupted immediately as a matter of routine.

Phase III

Phase III denotes the seventh-day rest which is always introduced.

Phase IV

Phase IV is the period of withdrawal, when it is decided that no further improvement can be obtained, and the dose of insulin is reduced to one-third or less of the coma dose, and interruption is carried out after two hours. This is repeated on four to eight successive days.

The treatment must be carried out in a place with a skilled and experienced staff, and the practitioner must be at hand during the period of 'shock'; the beginning of shock is counted from the time when motor disturbances appear, or contact with the external world, as measured by response to a voice or stimulation of any kind, is lessened. The dosage must be arranged so that the shock according to this definition begins in the second or third hour after an injection.

Technique

Insulin is always given intramuscularly, and interruption is carried out by glucose (250 to 1,000 c.c. of a 40 per cent solution at a temperature of 45° C.—Humbert and Friedemann) given through a nasal tube, which is removed immediately except in the case of patients who have been resisting taking nourishment, when the opportunity is taken of giving a tube feed. Waking should take place within twenty minutes. After waking, the patient is given some cake or biscuits and is supplied with hot-water bottles owing to the shivering that often occurs. He is allowed an ordinary luncheon. Care must be taken lest hypoglycaemic symptoms—'after-shock'—should appear, this being easily countered by a readily available supply of chocolate. For this reason patients should be kept under close observation for seven hours after the termination of 'shock'.

Deep coma (i.e. when no defensive reflexes of any kind can be elicited) should not be allowed to last more than one and a half hours.

Frostig claims greater safety by arranging the dosage of insulin empirically for each case, so that (i) unconsciousness does not occur till the third hour after insulin, and (ii) a Babinski response till the fourth hour.

Indications for interruption

In catatonic stupor it is considered advisable to interrupt during the stage of excitement and then to proceed to induce somnolence with subsequent doses. Interruption must never be later than five hours after the injection and must always occur when either the pulse-rate is irregularly or grossly disturbed, below 40, or over 120; also if hyperextension of limbs persists or cyanosis or hunger excitement occurs, this hunger excitement being characterized by wild excitement with fierce shouting and subsiding as soon as food is supplied. It is considered that interruption must be carried out intravenously in the following emergencies: (i) respiratory embarrassment; (ii) premature incidence of coma; (iii) obvious cyanosis; (iv) cardiovascular collapse; (v) vomiting; (vi) wild motor excitement (James, Freudenberg, and Cannon); and (vii) when convulsions occur in deep coma even after the administration of sugar (Müller).

Intravenous interruption

Intravenous interruption is done by means of injection of a 33 per cent solution of glucose, the amount being from 6 c.c., with the use of 20 c.c. syringes. Pulmonary oedema calls for the administration of strophanthin with glucose: 20 c.c. of 33 per cent glucose solution are given very slowly intravenously with 0·00025 gram of strophanthin.

Cardiovascular collapse

Cardiovascular collapse is managed by the injection of 1 c.c. of 1 in 1,000 adrenaline solution subcutaneously, with subsequent introduction of glucose. If this is impossible intravenously owing to the collapsed condition of the veins, it is given intracardially with the injection of 2 to 4 c.c. of a 33 per cent solution of glucose.

Sensitization

A watch must be kept for sensitization to insulin during the treatment.

Prolonged shock

Prolonged shock occurs when, in spite of the return of the blood-sugar to normal, the symptoms continue. This is countered by repeated small doses of sugar, by injection of adrenaline, by lumbar puncture, by intravenous injection of physiological saline, or by the injection of synthetic vitamin B_1 (e.g. betaxin, one ampoule intravenously) (Freudenberg). Dussik suggested also chromosmon, or dioxyacetone.

Other emergencies

Other emergency measures include lumbar puncture if the patient fails to wake after intravenous injection of glucose; bleeding in the same circumstances; and stimulation by the administration of a mixture of oxygen and 5 per cent carbon dioxide in cases of cyanosis, laryngeal spasm, and failure to wake after intravenous interruption. Dussik considered carbon dioxide very dangerous for this purpose and used oxygen liberally. Prolonged convulsions after interruption call for the same treatment as status epilepticus (amylene hydrate enema, sodium phenobarbitone 1 to 5 grains intravenously, pernocton, venesection).

During the rest of the day, besides the administration of chocolate if necessary for after-shock, treatment consists in mild occupations.

Reactivated psychosis

During Phase II, while the patient is not actually in coma, there is sometimes seen what is sometimes called the stage of reactivated psychosis, during which the patient rehearses his psychotic ideas. It is not considered wise to interrupt during this stage.

Contra-indications

Some consider it safer, after reaching the pre-coma dose, to give the same dose for three successive days before proceeding to the dose that is expected to produce actual coma. The contra-indications for beginning are especially cardiovascular and hepatic disease. Special care is necessary when the patient is asthenic with poor circulation and cold extremities.

Results

Very favourable results are claimed, the most complete being those compiled by Müller at Munsingen and containing the results from twenty-two clinics and institutions. Complete remissions and social recoveries being included together, the recovery rate for those treated for what is now regarded as the necessary length of time (i.e. at least sixty days and fifty comas) before the end of the first six months of the illness is 73·8 per cent, before the end of a year 63·3 per cent, before the end of two years 38·7 per cent, and 15·4 per cent for cases of more than two years' duration before treatment is begun. In addition a considerable number have improved. These figures, as Müller pointed out, represent at least double the spontaneous recovery rate, but it must be remembered that in some of the cases treated before the end of six months the diagnosis between schizophrenic and manic-depressive conditions may be uncertain.

The paranoid forms are supposed to be the most frequently influenced and then catatonic excitement and catatonic stupor in that order. There is some evidence that catatonic cases which have lasted over a year are more favourable than paranoid types which have not been treated until that time has elapsed.

(*b*) *Cardiazol Convulsion Therapy*

Rationale

The method of cardiazol injection introduced by von Meduna of Budapest is much simpler and appears to have had from the beginning some kind of rationale. Von Meduna argued that there was some kind of biological antagonism between schizophrenia and epilepsy. This conclusion was based primarily on the observation that epilepsy is very rare among schizophrenics, and that, when epileptics developed schizophrenia, the recovery rate from the epilepsy rose considerably.

Technique

The method consists in the intravenous injection of cardiazol (pentamethylenetetrazol) once every two days up to twenty injections. The average initial dose is 0·5 gram for men and 0·4 gram for women in a 10 per cent solution. The dose is increased on subsequent occasions if this is found necessary to induce a convulsion. The injection must be given quickly enough to produce a convulsion, which should follow 1 to 2 seconds after the injection and last 40 to 80 seconds. A large-bore needle facilitates the convulsive effect and makes smaller doses possible (Georgi and Strauss). After the epileptiform convulsion the patient sleeps for several minutes. If a convulsion is not produced, the patient is left with a feeling of extreme uneasiness. It is better to proceed almost immediately with a second injection on the failure of a first. There is apparently little danger, even if a second injection follows immediately, in spite of the alarming nature of the convulsive phenomenon. Meduna emphasizes the necessity of following the convulsive therapy with psychotherapy of a simple kind.

Dosage

Contra-indications

Mortality

Patients with cardiovascular or other serious organic diseases and patients over 45 years are best excluded. With these precautions, the mortality is no greater than by the insulin method, in which the latest figures suggest a death-rate of no more than 0·5 per cent, and the results claimed are similar. Cardiazol is said to be more effective than insulin in stuporous cases and less so in paranoid forms. One therapy will sometimes succeed when the other has failed. With both types of treatment, occasional surprising successes are achieved in cases of long standing (two or three years or more). With cardiazol, good results have been reported in chronic cases with depression and anxiety and hypochondriasis.

Combined treatment with cardiazol and insulin

Since it had been noticed that the occurrence of convulsions during the early hours of insulin treatment (in the pre-coma phase, in the second hour after insulin injection) was sometimes beneficial, it has occurred to many people to combine the two methods. Georgi and Strauss begin their combined method as soon as the coma dose of insulin has been determined. They give cardiazol two or three times a week one to two hours after the insulin injections. The two substances reinforce each other so that a smaller dose of cardiazol than usual is required to produce a convulsion. The authors believe that the change in the blood and tissues caused by the two drugs are essentially the same, but that with insulin the changes are slow and with cardiazol sudden. The combined treatment is interrupted within half an hour of the epileptic attack.

The ultimate results of these methods must wait for the passage of time for their assessment. Reports are to some extent conflicting so far; but already there can be no doubt that a therapeutic advance of very great importance, practically and theoretically, has been made, although not so great as some would believe.

Cyclohexyl-ethyl-triazol therapy

Recently a preparation called cyclohexyl-ethyl-triazol (triazol 156, azoman) has been introduced, which has the advantage of being satisfactorily injected intramuscularly. The dosage for intramuscular injection is approximately double that of the intravenous dose, which is from 0·7 to 2·5 c.c. of a 5 per cent solution; there are, however, individual variations, and it is best to begin with a somewhat smaller dose. The results are claimed to be similar to those with cardiazol.

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IV.–TOXIC INFECTIVE PSYCHOSES

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1.–DEFINITION

(*Synonyms.*—Exogenous psychoses; delirium and allied states; infective-exhaustion psychoses; toxic-confusional insanities; dysergastic reactions; amentias; symptomatic psychoses)

1322.] This group of psychoses is distinguished by two main criteria: (i) organic or exogenous factors predominate, and (ii) certain characteristic organic mental symptoms become manifest. When mental changes occur in patients with definite and obvious physical disorder or

Organic syndromes

disease, certain characteristic mental symptoms are shown with great frequency, which can be regarded as the direct result of these organic causes. These mental symptoms are called organic mental symptoms, and such syndromes are called organic syndromes.

Classification

It is convenient to divide organic syndromes into those which show an irreversible alteration in brain tissue and those which do not. There is no sharp line of demarcation between these two groups. The former group—the organic dementias, e.g. senile and arteriosclerotic dementia—is considered elsewhere (see PSYCHOSES, PRE-SENILE AND SENILE, p. 342; ALZHEIMER'S DISEASE, Vol. I, p. 354); only the potentially recoverable group is considered in this article.

Differentiation from functional syndromes

One of the basic principles of psychiatry is that the aetiology of every psychiatric case should be considered from three aspects: (i) organic or exogenous factors, (ii) constitutional factors, and (iii) psychological factors.

For the reasons given above, it is inferred that organic factors predominate in the organic syndromes; but this does not imply that constitutional and psychological factors can be neglected. Similarly, it is commonly held that constitutional and psychological factors predominate in the functional syndromes; but it certainly cannot be deduced that organic factors may not be extremely important as well; they often are. In other words, the differentiation between an organic and a functional syndrome—depressive, schizophrenic, hysterical, or whatever it may be—is constituted not by the presence of organic aetiological factors in the one and their absence in the other, but by the presence in the one and the absence in the other of the characteristic organic mental symptoms which are inferred to be the direct consequence of organic disorder or disease.

Just as there is no sharp line of demarcation between the two groups of organic disorders, so there is none between organic and functional syndromes. Cases showing symptoms characteristic of both groups are not described in this article.

Types of mental change

An example of the ill-defined boundaries of toxic infective psychoses is provided by a patient who shows mental changes and evidence of focal sepsis. In such a patient the mental changes may be (i) mainly or directly due to the focal sepsis; (ii) partly due to the focal sepsis and partly to other, usually constitutional, causes; or (iii) independent of the focal sepsis.

(i) When the mental changes are mainly due to the focal sepsis, certain characteristic organic mental symptoms result of the type shown most clearly in delirium. With the removal of the focal sepsis, such mental symptoms typically disappear, i.e. these cases are potentially recoverable, and such organic syndromes are examples of toxic infective psychoses. But if the mental changes partly depend on permanent cerebral damage, e.g. a cerebral abscess leading to a permanent dementia, the case belongs to the non-recoverable organic dementias.

(ii) In cases due partly to focal sepsis and partly to other causes the mental changes are often those of a functional type of reaction, such as depression, and are not considered in this article. Likewise, for the sake of clarity, such a very real entity as toxic neurasthenia, which many include under organic syndromes, is arbitrarily excluded (see p. 249).

(iii) If the mental changes are entirely independent of the focal sepsis, any attribution of the mental changes to the focal sepsis would be a mistake, and one that is not uncommonly made.

If organic mental symptoms are present, it can be inferred that there is some physical disorder, intoxication, or disease, which, if not obvious, should be sought. If organic mental symptoms are absent, it can be inferred that, although organic factors may play an important part in producing the mental changes seen, it is probable that other factors are more important.

2.–AETIOLOGY

(1)—Organic Factors

Unitary organic syndrome

Organic syndromes may be caused by every type of physical disorder, intoxication, or disease. But the question arises whether there is a unitary organic syndrome or whether the clinical picture varies in a specific manner according to the particular causal agent. Disorder at the physical level can certainly differ vastly in different diseases; it might therefore be supposed that the mental changes might also differ characteristically. Such expectations, which were formerly entertained, have not been fulfilled.

Changes produced by drugs

The conception of a unitary organic syndrome was first put forward in a classical monograph by Bonhoeffer in 1910, and since then numerous other investigators, such as Krisch, have been unable to find any single mental symptom, or group of symptoms, resulting specifically from one aetiological agent alone. The only plausible claims for specific effects have been advanced in connexion with the mental changes produced by certain drugs, e.g. mescal (Beringer), hashish (Joël and Fränkel), and perhaps cocaine (Joël and Fränkel). It therefore seems that all organic or exogenous factors produce the same general disturbance, and that they only differ in so far as what may, for convenience, be called the 'noxious dose' varies in intensity and duration from case to case. At one end of the scale the disturbance is typically acute and short-lived, e.g. delirium tremens; at the other end relatively slight and prolonged, e.g. some cases of pernicious anaemia.

Exogenous factors

Organic or exogenous factors can only be roughly classified according to the point on this scale where they usually produce their effect or according to their liability to provoke an effect at all. Thus there is nearly always some confusion with enteric fever but very seldom with diphtheria; and the fact that patients with meningitis are usually clouded and patients with tetanus typically very clear was found in the War, 1914–18, to possess diagnostic value.

(2)—Constitutional and Psychological Factors

The importance of the constitutional factor is clearly shown by the fact that one patient becomes delirious with pneumonia, whereas another does not. Some persons develop organic mental symptoms very readily. There is some evidence that this predisposition is more pronounced in some families than in others; it has also been found that these organic syndromes are much commoner in families of (alcoholic) delirium tremens patients than in the ordinary population or in the families of chronic alcoholics who do not develop delirium tremens.

It has been stated that the 'noxious dose' always results in the same general disturbance, only varying in intensity and duration from case to case; but Hoch, Kirby, and many other authors have clearly demonstrated that the symptoms depend not only on the intensity and duration of the 'noxious dose' but also on the constitution, equipment, and experiences, both past and present, of the individual. The same general features, the typical organic mental symptoms, are constant; but the special colouring given by the individual to these constant features varies greatly. These individual factors have an extremely important bearing upon the clinical picture and prognosis.

3.–PATHOLOGY

Adolf Meyer stated that these organic syndromes were 'due to disorders of nutrition and circulatory support of the brain (the effect of poison and abnormal nutrition, anaemia, hyperaemia and oedema)'; but amplification in detail of such a general statement is yet to be made, and very little is known about the underlying pathology. Careful investigations to discover a predilection of different poisons for different parts of the brain have had negative results.

4.–CLINICAL PICTURE

The variety and number of synonyms used to designate the toxic infective psychoses is due in part to the fact that the clinical picture can vary so greatly.

The classical prototype of these organic syndromes is seen in delirium; but, although Kraepelin used the term delirium very widely, many would be reluctant to apply it to several of the conditions that must be included. Thus Hart pointed out that whereas, for example, febrile delirium forms an easily recognizable and characteristic syndrome, a series of states can be found that range by imperceptible gradations from this typical picture to conditions with apparently remote connexions.

(1)—Classical Delirium

(a) *Physical Symptoms*

These usually include restlessness, incontinence (especially urinary), impaired sleep, and a temperature of about 100° F. even without demonstrable infection. There is usually evidence of the somatic accompaniments of emotional states, such as rage and fear (sweating, pallor, tachycardia), in addition to the somatic accompaniments of infection or intoxication. The appetite is poor, the tongue dirty, and the breath foul. Slurred speech is frequent and paraphasia not uncommon. Evidence of incoordination is brought out by attempted movements. *Reflexes* The abdominal reflexes are usually diminished or absent; the other reflexes are inconstantly disturbed. The pupils often react sluggishly to light. Nystagmus is common, and some patients complain of diplopia. These somatic changes are closely related to the degree of general disturbance but, like the mental changes, not specifically to the aetiological agent. It will, however, be obvious that the physical and biological accompaniments of such relatively clear-cut syndromes as toxic goitre and enteric fever will be superimposed.

(b) *Mental Symptoms*

The outstanding features, although interrelated and interdependent, can be arbitrarily classified. It may perhaps not seem necessary to emphasize certain categories of disturbance as the most fundamental, from which all other manifestations can be deduced; but analysis is impossible without doing so. The following is a convenient classification, the third category being the most important: (i) variability; (ii) increased suggestibility and responsiveness, together with a tendency to elaborate, embroider, or confabulate; (iii) impairment of intellectual capacity shown in memory and mental grasp, and in clouding of consciousness; (iv) hallucinations, especially visual; (v) paranoid features; and (vi) restlessness, i.e. psychomotor activities variously elaborated.

Variability (i) Variability is perhaps the most constant feature of classical delirium. Unless the patient is so toxic as to be in a state of stupor, the clinical picture shows typically constant change, which often occurs with remarkable rapidity and reaches striking extremes.

Increased suggestibility and responsiveness (ii) The variability is clearly a manifestation of the increased suggestibility and responsiveness. These patients react to stimuli arising from their bodies and from the outer world with abnormal facility and intensity. Often coupled with this excessive reaction, there is a tendency to embroider and to amplify. The increased suggestibility, with these tendencies at work, can sometimes be dramatically shown by inducing patients to read from a blank sheet of paper. In an extreme *Confabulation* form this manifestation is known as confabulation. Thus patients sometimes give entirely unfounded circumstantial accounts of where they have been the day before and will elaborate further details on pressure. Various 'excuse confabulations', e.g. the explanation of urinary incontinence by the statement that it had been raining, and the symptom of the prospective imaginary appointment, often given as a reason for leaving bed or hospital, are other common examples. These same features are shown in the various and frequent misinterpretations, every type of experience being liable to be misinterpreted, e.g. a sore tongue is attributed to malicious burning; the bed cover is thought to be a napkin; the doctor is thought to be a relation; and the nurses may be called impertinent maids. A more complex example, depending on two sensory misinterpretations, was shown by a patient with a carbuncle on his buttock, who believed that he was in a burning boat. It is not uncommon for patients to believe they are in motor cars, ships, or lifts owing, presumably, to disturbance of vestibular function variously elaborated. These misinterpretations are often clearly founded upon expectation or fear and reveal a paranoid tendency [see (v)]; but probably the most important factors are the difficulty in mental grasp and the clouding of consciousness.

Misinterpretation

(iii) There is always some impairment of intellectual capacity, the degree of which differs greatly from patient to patient and often in the same patient from minute to minute [see (i)]. Although these patients not infrequently appear to be quite clear for short periods of time, sustained effort always brings defects to light. Thus attention, though varying greatly, is poorly sustained, concentration difficult, thought often laboured, and speech repetitive or disconnected. These patients tire readily, become distracted by outside happenings, or sink back into the confusion from which they have been partially roused [see (ii)].

Impairment of intellectual capacity

Memory for recent events is particularly affected, that for remote events often patchy and vague. Retention is poor and calculation usually bad. The 100 - 7 test (subtraction of 7 serially from 100) is performed slowly, with dwindling and perseveration, when attention can be sustained long enough for such a test. Ability to recount an episode or to repeat a story is poor, the point being missed and the content muddled.

Memory

The disturbance in this invariable and basic aspect of a delirious reaction is, like all the other disturbances, usually more pronounced in the latter part of the day, during the night, and for a short time immediately after waking in the morning. During the onset of the illness and during convalescence patients often become restless and confused at night, whereas their condition in the day appears normal.

(iv) Visual hallucinations are the most frequent and are highly characteristic. In one series of 106 cases they were definitely recorded in 72 and were probably experienced in many more. Although some schizophrenics experience symbolic visions, definite visual hallucinations point, for practical purposes, to an organic syndrome; and in organic syndromes alone can they appear as real as an ordinary perception. They are often very elementary, such as kaleidoscopic patterns or figures, and tend to appear at night or when the patient is half awake. With a greater degree of elaboration, detached pictures or moving, ill-defined figures or forms are seen, which appear like a changing

Visual hallucinations

pantomime or cinema show. These detached pictures are often felt to be devoid of personal implication and can even be found to be mildly entertaining. Other common hallucinations are ghost-like forms or bugs and beetles, and animals, usually smaller than the natural size, are highly characteristic. The visual hallucinations can be terrifying, and distortions in size are frequent. Vivid visual hallucinations are commonest in acute intoxications and indicate a fairly profound disturbance. They are naturally provoked more readily in patients of a highly visual or eidetic type, and for the same reason in children.

Auditory hallucinations

Hallucinations affecting other senses are less common. In 106 cases auditory hallucinations were recorded in 44 instances only. These auditory hallucinations often persist for a time after visual hallucinations have disappeared. They may take the form of 'third person discussions'; the voices of relations, sometimes in reproach or torment; direct accusations or threats; or mere vague cries, bells, or music. A very much smaller number of patients complain of unpleasant tactile sensations, such as bugs crawling, or of unpleasant smells.

Tactile and olfactory hallucinations

Relation to misinterpretation

Many hallucinations are based on illusion and may therefore more accurately be described as misinterpretations. Thus a crease on the carpet or a crack in the wall is thought to be a snake, which is seen to glide away; and the whispered gossip of nurses is thought to be the voices of plotters scheming destruction.

The personal contribution of the recipient to stimuli upon his sense organs is as essential a part of a perceptual situation as the stimuli themselves. Without such personal contribution the stimuli could not be recognized or mean anything. In delirious states the capacity to recognize sensory stimuli correctly and to relate them appropriately is impaired. The personal contribution becomes unduly prominent, so that fears and expectations are readily confirmed, sustained critical capacity being reduced [see (iii)] and the capacity to elaborate or confabulate being increased [see (ii)].

Paranoid features

(v) Paranoid features are extremely common; indeed paranoid attitudes are invariable, for all these patients at some time and to some extent feel themselves to be the subject of persecution or annoyance.

The points mentioned are clearly shown in the definite delusional ideas, which are typically transient and badly systematized, i.e. variable. Their occurrence depends, in part at least, on the difficulty in mental grasp, which also is variable. If a difficulty is experienced in a clear grasp of what is taking place, it is comprehensible that doubt and suspicion should arise. Further, they partly depend on the increased suggestibility and responsiveness, for the consequent (uncorrected) misinterpretations often clearly become the starting-point for delusional ideas or are empanelled to confirm those already present.

It is impossible to draw a line between uneasy apprehension and perplexity and definite doubt and suspicion. The vast majority of these patients express ideas of reference and believe they are talked about in a disparaging way.

The more crystallized beliefs are shown by talk of calamities, plots, gangs, wars, and revolutions. The talk is often rather tentative and vague; all is dark and far from clear. Many of these patients never pass beyond what might be called the 'Watson stage' of a paranoid development and never achieve the clarity and certainty of the 'Sherlock Holmes stage'. Others believe or suggest that they are to be poisoned, killed, robbed, kidnapped, or subjected to some form of physical torture; or that their loved ones are in danger. Others believe themselves to be accused of immorality or that their spouses or lovers have been unfaithful.

A prolonged but relatively mild disturbance clearly favours the development of more systematized delusional ideas; for, if the confusion is very great, the retention of the capacity to form related or connected concepts, necessary to systematized delusional ideas, is impaired or lost.

Restlessness

(vi) Restlessness varies from the most highly co-ordinated and purposive psychomotor activities down to the simplest movements barely, if at all, distinguishable from tremor. Those with the greatest disturbance toss and turn, pick and grope, kick and rub. These patients may become blindly violent, regardless of the consequences. The restlessness may cause severe bruising or chafe and inflame the skin, making nursing very difficult. An aimless flopping and rapid jerky bird-like movements are highly characteristic, especially perhaps in the early stages of illness. Of greater complexity are the extremely common investigating and occupational activities. The former, often attempts at re-orientation, merge into the latter, as in the case of a tailor who searched for the imaginary scissors to cut his imaginary cloth; and the occupational activities are often good examples of the tendency to embroider or amplify, a sort of motor or acted confabulation. In their simpler form, the investigating activities can be seen in vague searching of the bedclothes and immediate surroundings. Sometimes the patient engages in more complicated dramas, as instanced by a man with a police record who thought he was about to be 'put on the spot'. Many activities are clearly reactions to delusional ideas or hallucinatory or illusional experiences—reactions of 'fear, flight, and fight'.

Mood

A dreamy drifting dazed state, very labile, with rapid changes, is common. States of puzzledom, anxiety, irritability, mistrust, and definite suspicion are the general rule. Apprehension suddenly changes into fear, and in many cases fear is the dominant affect throughout. Most are at times deeply stirred emotionally and are depressed, whimpering, and fearful rather than happy and jovial. Talk of suicide is by no means uncommon, and many make definite suicidal attempts.

(2)—Variations from Classical Delirium

Intellectual impairment

All the variations from the picture of classical delirium show at some time the basic organic mental symptom, i.e. some evidence of what has here been called intellectual impairment, as shown in disorder of memory or confusion.

It is only possible to touch briefly upon three of these variations, and it must be understood that there are often intermediate or mixed forms. Twilight states, such as occur in epilepsy, hysteria, or after head injury, are not considered in this article, because they are certainly extremely uncommon in exogenous psychoses, if indeed they occur at all in uncomplicated cases.

(*a*) *Simple Confusion*

In many cases a fully developed delirious reaction is never seen. During the day such patients may complain merely of feeling weak and tired and of difficulty in concentration, and examination may only disclose some mental dulling or slowness; but during the night, and in the more severe cases during the day as well, definite confusion with transient disorientation and difficulty in grasp may become more obvious. With this are often coupled visual hallucinations, at first hypnogogic or of the elementary or simple type that has been described. In addition there may be transient evidence in minor form of the labile mood changes described in classical delirium, as well as fleeting paranoid tendencies and ideas of reference. Restlessness and broken sleep are also usually observed.

Bromide intoxication

These states of mild or attenuated delirium are not uncommon in the less severe degrees of bromide intoxication which not infrequently occur; and the diagnosis is often missed because of the predominance of the depressive or anxiety symptoms for which bromide has been ordered. An apparent change for the worse in any functional syndrome taking the form of increased suspicion, nocturnal restlessness, and especially increased difficulty in grasp should always suggest the possibility of bromide intoxication; and when tests for intellectual capacity (memory, calculation) reveal defects, these suspicions should be strengthened.

(*b*) *Korsakow or Amnesic Syndrome*

In this variation, which is not confined to alcoholism, memory disturbance is the most striking feature, and not difficulty in mental grasp and clouding of consciousness. On the contrary, these patients may appear at first sight to be normally quick in the uptake and often speak with great fluency and apparent plausibility; but examination reveals gross memory defects, which are most obvious in the appreciation of time relationships, especially for recent events. In order to compensate, as it were, for their defects of memory, these patients confabulate and often show the most striking suggestibility, so that they will tell the most circumstantial and elaborate tales of their recent doings, entirely fictitious, which they will amplify with full and invented details on little pressure (see also Vol. I, p. 285; and p. 337).

(*c*) *Hallucinatory Syndromes*

In these syndromes, with or without an initial stage of full delirium, auditory hallucinations of persecution predominate. This is not necessarily associated with gross clouding or difficulty in mental grasp, so that these patients may be able to continue at or to return to work. These auditory hallucinations often possess a quality of the most vivid reality, are often accompanied by paranoid delusional ideas, and can be extremely disturbing, even leading to suicidal attempts.

(3)—Puerperal Psychoses

Organic types of reaction of delirious or allied types are not infrequent as the result of infection or exhaustion in the puerperium. It would, however, be a mistake to suppose that all puerperal psychoses should be regarded as exogenous. There is nothing specific in form or aetiology about puerperal psychoses, which can be of any type; and the importance of organic factors in their production is often over-emphasized. The same criteria should be used in deciding whether or not puerperal psychoses should be regarded as exogenous as are used in any psychosis occurring at any time.

(4)—Personal Contribution of the Individual

So far attention has been mainly confined to the general features which these organic syndromes share in common; but Hoch, Kirby, Wolff and Curran, and many other authors have emphasized that the final reaction cannot wholly be understood in terms of the intensity and duration of what has here been called the 'noxious dose'. The previous personality of the patient, as revealed by the physique, previous mental illnesses, individual characteristics, habits of reaction, past experiences, age, sex, and intellectual endowments, must also be taken into account.

In addition to constitutional predisposition, both the young and the elderly and arteriosclerotic are more liable to develop these organic reactions than are those in the prime of life and health. Further, the individual is not only of importance in determining occurrence but is of the greatest importance in shaping the content. Thus, frank manic and depressive features often colour the reaction of patients who have previously suffered from mental illnesses of these respective types. Groups of patients have been observed in several illnesses, and, whether the 'noxious agent' was the same or different, the symptoms were usually strikingly constant. Again, a delirium superimposed upon a depressive state, not uncommon in bromide intoxication, is usually coloured by the typical self-reproachful ideas and other depressive features. Patients with marked characteristics, such as suspicion and pomposity, usually show these same characteristics in intensified form or even in caricature. The naturally timid show fear to an extent that the devil-may-care do not. Such points have a practical bearing as well as a scientific interest.

It is easier to trace this personal or individual factor when the disturbance is relatively slight; for, if the disturbance is too great, the individual colouring to the impersonal organic mental symptoms becomes blurred.

5.–COURSE AND PROGNOSIS

The typical outcome is 'kill or cure', complete recovery taking place in a relatively short period of time unless the patient dies. The course and prognosis necessarily depend to a major extent on the nature of the 'noxious dose', i.e. on the ordinary course and prognosis of the disease or intoxication responsible for the condition. In the vast majority of cases, when physical recovery takes place, the organic mental symptoms clear up, so that the mental prognosis is excellent, recovery being rapid and complete. Thus, in one large series, all of sufficient severity to warrant special hospital care, the maximal disturbance in 75 per cent was over in less than three weeks, and many got better in a much shorter time.

Broadly speaking, the unstable and psychopathic, the young, and the mentally defective seem specially liable to develop wild and impulsive reactions.

Mortality

Death is inevitable in fatal illnesses, such as bacterial endocarditis; but the physical prostration consequent upon restlessness and excitement may induce a fatal issue which otherwise would not have taken place.

Suicide

Bonhoeffer considered that suicide and self-injury were rare in alcoholics, except in the initial stage of terror. In quite a high proportion of severe cases, however, suicide is attempted (7 in 106 cases in one series), and this possibility should be borne in mind in the case of psychopaths and those with depressive temperaments, especially if they have suffered from definite depressive attacks.

Mortality in alcoholic syndromes

The available figures of mortality in alcoholic syndromes vary widely between 1 and 37 per cent, the older writers giving the higher mortality (Meggendorfer). The majority put it at about 9 per cent (Kraepelin; Bonhoeffer). Severe reactions, especially those with focal cerebral signs, are held to run a short course and often to prove fatal. Drunkards who have been abstinent are said sometimes to die quickly after taking relatively small amounts of alcohol.

The prognosis of 'kill or cure' is subject to the following exceptions:

(i) Delirium as an episode in a pre-existing psychosis. Confusional states due to alcohol or to bromide are not uncommon in independent psychoses. The history alone may reveal this important fact; and, when these organic mental symptoms clear up, the symptoms due to the pre-existing psychosis may remain.

(ii) Delirium as a prelude to other psychoses. Psychotic reactions, such as schizophrenic, hallucinatory, depressive, and paranoid states, may become evident after a delirium though not previously apparent. Indeed, certain schizophrenic reactions can for a time be indistinguishable from 'true' delirium, if such a term can be used.

It is wise to be more guarded in predicting the probable duration and outcome when the facts available about the previous personality of a patient afford in general grounds for psychiatric concern.

Thus Kirby, in a careful study of the previous personality of 102 cases of alcoholic hallucinosis, found that those patients who developed systematized delusional ideas and did not recover relatively soon always showed evidence of serious maladjustment prior to the onset of the illness. Other investigations have, broadly speaking, given similar results.

Certain danger-signals are also revealed by a study of the symptoms of the delirium. Thus, delirium strongly tinged with passivity feelings, bizarre hypochondriacal preoccupations, or other schizophrenic features should suggest the possibility that a schizophrenic illness may supervene (Bonhoeffer). Schizophrenic-like features are normally very rare in delirious reactions except in the mentally defective or very young.

(iii) Delirium followed by incomplete recovery and lack of insight. The conditions favourable for the development of severe paranoid features appear to be (*a*) that the 'noxious dose' should be prolonged but relatively light, and (*b*) that the recipient should be suspicious or touchy, i.e. somewhat paranoid. Patients affected in one or both of these ways often fail to gain insight and continue to believe that they have been shamefully or badly treated when they have recovered in other respects. These accusations may be believed by others, unless a special warning has been given. These querulous complainers merge into the more definite paranoid states. Finally, delirious reactions in the elderly, or in those with cerebral arteriosclerosis, may clear up, leaving a permanent organic dementia of greater or less degree which was not present before the onset.

Difficulties in prognosis

The great importance of the constitutional and personal factors in assessing prognosis renders figures based upon the gross examination of a large number of cases of relatively little value, especially in view of the great variation in the intensity and duration of the 'noxious dose', even if of the same type in different cases. These prognostic difficulties and variations are well seen in alcoholic states and can be attributed to (i) the varying quality and quantity of the 'noxious dose', (ii) the variation in susceptibility of the individual recipients, and (iii) the fact that the recipients contain a high proportion of abnormal and maladjusted persons.

Prognosis in alcoholic states

Bumke and Bonhoeffer believe that chronic sequelae of Korsakow and hallucinatory and paranoid types should be anticipated if there are clear neuritic signs, or if the delirium is anomalous in form or duration or does not end by crisis.

Kraepelin gave the average duration of alcoholic delirium tremens as 3 to 6 days, with the larger number in the earlier period. He also found in his cases of alcoholic hallucinosis a complete recovery in nearly half, but they often had later attacks; a quarter passed into a weak dementia; and a quarter became chronically deluded and hallucinated. Korsakow was not so pessimistic about the syndrome which bears his name as are other authorities, such as Bonhoeffer and Meggendorfer, who stated that a patient with the fully developed syndrome rarely recovered completely, the usual outcome being a silly, cheerful, irritable condition with a lack of initiative and a disturbance of memory and grasp.

6.–DIAGNOSIS AND DIFFERENTIAL DIAGNOSIS

The organic mental symptoms are evidence of an organic or exogenous factor, but they can readily be missed when the symptoms of some other type of reaction, such as anxiety and depression, are also present or appear to predominate. The special difficulties provided by bromide intoxication have been mentioned on page 324. Special attention should therefore be paid in all psychiatric problems to the examination of the sensorium to discover if there is clouding, difficulty in grasp, or impairment of memory. The terms 'clouding' and 'confusion' should not be loosely applied to all patients that do not respond briskly and appositely. Depressive difficulty in thinking or depressive retardation can give the impression of a confusion, and the same applies to some cases of schizophrenic perplexity; but it is usually possible to differentiate such cases from true organic confusion. Organic features, due to bromide intoxication, are not infrequently superimposed on such conditions.

Very great difficulty, however, may arise in connexion with certain manic and schizophrenic excitements; and acute schizophrenia may for a time be symptomatically indistinguishable from the delirious states. From the practical point of view, however, those cases in which a real difficulty in differential diagnosis arises need the same treatment as do delirious reactions.

7.–TREATMENT

Specific treatment of cause

General principles in management

Treatment must be first directed to the physical disorder or disease responsible for the condition. Proper care and management depend on the recognition of certain general principles, not the least important of which is that the personality of each patient must be taken into account, neglect of which often leads to a great increase in restlessness and excitement.

These patients become more clear when specially stimulated but tend to recede into confusion or to lose contact with their environment when this special stimulation ceases. Thus, frequently, they must be shaken before a relevant answer can be obtained. The converse is also true. To a large extent these patients are at the mercy of their environment, for they are unable to discriminate or to differentiate in an adequate manner what is going on round them or to correct false impressions. Anything therefore which produces a blurring of perception or makes discrimination or differentiation difficult for any reason tends to make their condition worse. Thus hallucinatory forms tend to emerge from shadows, and the whispering of nurses is elaborated into the belief that plotters scheme.

Environmental factors

The practical application of these principles will be obvious: it is most important to provide surroundings that reduce the chances of misinterpretation to a minimum. Thus it is most important to provide, as far as possible, quiet clearly-lit simple unchanging surroundings with familiar faces and objects. Anything new, complex, or changing can be most disturbing; thus a patient who was quiet and clear became restless and confused when taken to the X-ray room.

For the same reason nurses should be changed as seldom as possible. These patients should never be left alone, but someone, and so far as this is possible the same person, should always be at hand to give explanation, re-orientation, and reassurance. It is often desirable to have some light in the room when the time comes to go to sleep; and immediate explanation and reassurance should be given as soon as the patient wakes up, when he tends to be specially confused.

In other words, these patients are nearly as suggestible in one direction as in the other and can be soothed and quietened nearly as readily as they can be upset and perplexed. A knowledge of the particular problems and fears of the individual is of very great aid in achieving maximal tranquillity, and by the application of the above general principles, as modified in the light of each individual problem, the chances for the production of misinterpretations, or for their continuance, can be very materially reduced.

Nurses

Nurses specially trained or experienced in dealing with mental illness are of inestimable value, for they are used to exercising calm and tactful management, do not become alarmed or flustered, and accept paranoid symptoms as evidence of illness and do not resent them as evidence of unjustified personal criticisms as the inexperienced nurse is so apt to do. Although many patients can be nursed entirely satisfactorily in their own homes, it is often necessary, because of the restlessness and excitement, and in order to ensure adequate investigation and facilities for treatment, to admit these patients to hospitals or nursing homes. Not infrequently they become more disturbed for a time as the result, the new situation being more difficult to grasp and causing confusion.

In general the disadvantage of a temporary increase in confusion consequent upon a change of surroundings is more than counterbalanced by the advantages of better facilities for investigation and treatment. Thus, the rapid improvement observed in patients unmanageable at home after admission to the skilled care obtainable in a psychiatric clinic is often most impressive. If a single room is not available, a screen round the bed, which helps to cut down the number of disturbing stimuli, is often of help.

Treatment of possible delirium-producing factors

Fever, alterations of acidosis, and oedema are considered possibly to be direct delirium-producing factors, but little beyond what is indicated from the general medical point of view can be done to influence them.

Large amounts of antipyretics seem usually to aggravate the mental picture. Lumbar puncture has been advocated to relieve the oedema, but it is also of doubtful value, except in delirium tremens in which encouraging claims have been made.

Diet

An adequate amount of fluid and nourishment must be taken. These patients are often allowed to develop a most regrettable condition of dehydration and starvation (acidosis). With tactful and skilled nursing it is usually possible to ensure that an adequate amount of nourishment is taken. The diet should be soft, and fluids, including milk, should be given in large quantities. Should food and drink be persistently refused, recourse should be made to tube feeding; but with skilled nursing this is seldom necessary. Glucose drinks are helpful in acidosis and some give also sodium carbonate, 60 to 120 grains, thrice daily. Intravenous injections of salines for dehydration are often difficult to give, appear to help little, and cannot be recommended. Usually the only methods available to remove toxins are to stimulate excretion and to remove toxins from the bowels by purgation.

Detoxication

Treatment of bromide intoxication

Bromide can be rapidly eliminated from the body by the administration of sodium chloride 90 to 180 grains a day in addition to the usual diet. (For the treatment of other drug intoxications see Vol. IV, p. 253.)

Treatment with drugs

Cardiac stimulants, e.g. camphor and caffeine, should always be kept ready in severe delirious reactions. The administration of digitalis depends on general medical principles. The fewer sedatives that are given the better, and they should preferably be given for the night and in sufficiently large doses. They should be drugs that are easily excreted and not accumulated in the body. Paraldehyde 2 to 4 drachms and, if necessary, morphine sulphate and hyoscine hydrobromide are probably the best. The barbiturates should be used sparingly, but amytal and allobarbitone have their advocates. With adequate care and management, delirious excitement can usually be controlled without adding to the already existing intoxications by medicaments.

Hydrotherapy

Treatment by continuous baths is very valuable when excitement is extreme. Cold wet packs are also very valuable and can produce a most sedative effect (see Vol. VI, p. 587). They must, however, be used with care to avoid any danger of collapse.

Restraint

As little physical or mechanical restraint as possible should be practised. It is sometimes necessary to tie the hands, e.g. when attempts are made to rip off bandages. It is also often necessary to pad the sides of the bed to avoid bruising. The best restraint is that exerted by skilled and tactful nursing; and more than one nurse may be necessary. The patients must be prevented from damaging themselves, and there is also the danger of attempted suicide.

Delirious reactions in the senile

Senile patients usually react well to skilled nursing. In some cases of protracted senile delirium with severe restlessness small repeated doses of hyoscine hydrobromide $\frac{1}{150}$ to $\frac{1}{100}$ grain three or four times a day by mouth appear to be helpful.

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V.–ALCOHOLIC PSYCHOSES

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1.–AETIOLOGY

Causation of alcoholic psychosis

1323.] There is no satisfactory explanation of why some people who drink to excess have a particular mental disturbance. Some form of acute intoxication with disturbance of consciousness is an inevitable effect of a large intake of alcohol on any single occasion, but years of excess have usually preceded an attack of delirium tremens or of alcoholic hallucinosis. The physical effects of alcoholism, especially as regards nutrition, probably play a part in the causation.

Of alcoholism

The reason why some people drink to excess is rather less obscure; social and psychological influences can be detected in individual cases, and in large series of cases of alcoholic psychoses and delinquency the social factor can be inferred from a comparison of statistics for different years, countries, and occupations. Many drunkards are found to have had poor mental health before they became alcoholic; they have been sensitive, easily depressed, dissatisfied, ill fitted to meet the troubles of daily life, and prone to anxiety. Of those who become periodic drinkers, 'dipsomaniacs', about a fifth tend to fluctuations of

Psychological factors

mood, chiefly explosive psychopaths; in only half of these can the mood changes be held directly responsible for the drinking: they are mainly sensitive people who drink when overwhelmed by the depression due to external circumstances or inner conflicts; a few drink when hypomanic. The differences in the findings of various observers as to the frequency of psychopathy as a cause can be attributed in part to the different social or psychiatric composition of the groups of alcoholics studied but mainly to the different weight put on the evidences of maladjustment during the period of the patient's chronic alcoholism; thus his sexual, particularly his marital, difficulties, his lack of persistence in carrying out ordinary plans of conduct, his food habits, his readiness to rationalize his failures, and his weakness in yielding to social pressure may in many instances be the outcome, rather than among the causes, of his drunkenness. All writers concur in emphasizing the preliminary restlessness of body and mind which for a day or two precedes bouts of drinking; it is often accompanied by sleeplessness, sometimes also by anxiety attacks, and it occurs periodically in more than half of all chronic alcoholics.

The personality and the characteristics of alcoholics are not peculiar to them; their traits can be found also in many psychopaths who have no such drug addiction; and, since no satisfactory study has been made of the personality of those who drink alcohol all their lives in fairly large amounts yet remain well adjusted and apparently healthy, it is more proper to assess the psychological factors in any individual drinker than to dogmatize about drinkers as a group.

There is ground for believing that those who pass from an alcoholic hallucinosis or delirium tremens into a chronic paranoid psychosis are constitutionally schizoid persons, but it would be unsafe to suppose that this had had much to do with their original alcoholism. It has been found that there were far more total abstainers in representative samples of schizophrenics and manic-depressives in New England than in a group of normal controls; on the other hand, observers have reported a high proportion of 'pyknic-syntonic' persons, i.e. such as have the build and character common in manic-depressives, among chronic drinkers; constitutional tendencies towards a particular mental disturbance may become manifest during an alcoholic psychosis.

Relation of alcoholism and alcoholic psychoses to other mental disorders

The intrinsic relationship of alcoholism, including alcoholic psychosis, to other forms of mental disorder is not clear and is probably unspecific, as is also the heredity of this addiction. There is no satisfactory evidence that the tendency to addiction is genetically transmissible as such, though parental and other postnatal environmental influences may favour this manifestation of maladjustment.

2.–PATHOLOGY AND MORBID ANATOMY

Alcohol content of blood

Differences between chronic alcoholics and non-drinkers in respect of the alcohol in the blood have been reported by some observers. Fleming and Stotz found that after oral ingestion of alcohol the alcohol content of the blood in chronic alcoholics rose more rapidly, reached a higher maximum, and fell more quickly than in abstainers, the alcohol in the cerebrospinal fluid behaving similarly. When, however, the alcohol was administered intravenously, there was no significant difference in the rate at which it disappeared from the blood of heavy drinkers and of abstainers; in the cerebrospinal fluid it reached and maintained a slightly higher level in abstainers than in drinkers. It was therefore assumed that the differences found in the blood depended on the rate of absorption from the gastro-intestinal tract. Bernhard and Goldberg, using a different analytical technique, could not even discover significant differences between the blood-alcohol curves of heavy drinkers and abstainers after oral ingestion of the drug. Delirium and other psychoses cannot be accounted for in terms of the alcoholic content of blood or of cerebrospinal fluid.

Avitaminosis

The alimentary tract has come to be regarded as an important factor in chronic alcoholism not only because of its influence on the rate of absorption of alcohol but also because experimental and histological evidence show that a deficiency of vitamin B_1 probably contributes to some of the symptoms, particularly when there is much neuritis, as in Korsakow's syndrome. In almost all forms of severe chronic alcoholism, however, there is commonly some polyneuritis. It is doubtful if the avitaminosis alone is directly responsible for the damage to neural tissue; some think it acts by facilitating the toxic action of alcohol; others, who would incriminate the liver, hold that other essentials besides vitamin B_1 are lacking. In any case, alcohol alone cannot be regarded as the toxic factor in the alcoholic psychoses here considered.

Morbid anatomy

Although a histologically normal brain is uncommon in chronic alcoholism and alcoholic psychoses, the anatomical changes reported are not characteristic. Some writers, however, have found in Korsakow states, as in polio-encephalitis haemorrhagica superior, fairly constant changes in the brain-stem, especially in the corpora mamillaria, where haemorrhages, formation of new vessels, and proliferation of the intima occur. The process extends from the beginning of the medulla oblongata to the neighbourhood of the anterior commissure. The posterior corpora quadrigemina, the medial part of the oculomotor nucleus, the central grey matter, and the medial wall of the third ventricle are often affected. These changes, obvious in polio-encephalitis haemorrhagica superior, can be detected in most of the fatal cases of alcoholic Korsakow psychosis; they are probably not inflammatory but toxic-degenerative.

Disputed findings are those reported in the cortex by Creutzfeldt and others and the degenerative cellular and glial changes in the medial layers of the corpus callosum and anterior commissure described by Marchiafava. The significant likeness of the findings in alcoholic Korsakow psychosis to those in pellagra has been pointed out (Carmichael and Stern); deposition of large amounts of lipochrome in the cortical nerve-cells, neuroglia, and mesoglia is conspicuous in both conditions.

3.–CLINICAL PICTURE AND PROGNOSIS

The symptoms of acute alcoholic poisoning are detailed in Vol. I, p. 281. The common psychotic forms are delirium tremens, alcoholic hallucinosis, chronic delusional states or demoralization, and Korsakow's syndrome.

(1)—Delirium Tremens

This is no longer believed to be frequently the sequel of sudden withdrawal of alcohol from drunkards. In the cases which gave rise to this belief the infection or other illness, especially pneumonia, which led to the patient's admission to hospital, was probably an important cause of the delirium; when an injury was present, e.g. a fracture, this was often due to the incipient delirium. In the early stages, which may extend over weeks, the patient is agitated and jumpy, with terrifying or arresting visions at night. Usually, however, there is a fairly abrupt onset. The delirium is severe, with much terror and some euphoria. Consciousness is not clear but dreamy; the patient is disoriented as to time and place, but not as to his identity, and pays little attention to his surroundings. He has many hallucinations—chiefly of sight, and, in diminishing degree, of equilibrium, sensation, and hearing. The vivid visions constantly change and are often horrible and frightening. Vestibular sensations of rocking and flying are common; patients also complain of cutaneous irritation, e.g. by spiders or ants running about on them. Auditory hallucinations are not common or definite; they are usually of noises or music, but not voices. The suggestibility of the patients is such that they can be persuaded to see visions, read from a blank paper, or use imaginary articles, by a simple pretence or assurance that they can. They may act some scene in which these hallucinations and illusions, as well as past experiences and wishes, play a prominent part; or they may carry out some customary activity (occupational delirium). Ataxy, coarse tremor, jerky speech and writing, and very active deep reflexes are common neurological findings; extra-ocular pareses may develop in severe cases; and sweating, rapid pulse with increased tension, dilated heart, albuminuria, and pyrexia are the rule. Epileptic attacks occur in a tenth of the cases. Sleeplessness is absolute throughout.

Onset

Delirium

Occupational delirium

The prognosis for the delirium is good, provided that there is no circulatory failure. Usually before the end of the first week there is a crisis, during which the patient falls into a deep sleep, to awaken lucid. Fatal cases are usually those with pneumonia or with a typhoid delirium passing into coma; usually the latter are due to polio-encephalitis haemorrhagica superior. Although patients recover from this delirium

Prognosis

tremens, the likelihood of a subsequent attack is greater if they persist in drinking. Sometimes the delirium passes into a chronic Korsakow state.

(2)—Acute Alcoholic Hallucinosis

In this condition auditory hallucinations, abusive or threatening, occur during relatively clear consciousness. It is often the sequel of an alcoholic orgy in fairly steady drinkers. *Onset* At the onset there is apparent hyperacusis, followed by noises in the head and poorly differentiated hallucinations, e.g. banging, shouts, bells, and screams, which soon become voices that taunt the patient with things he is ashamed of, read his thoughts, describe his most private conduct, or otherwise insult and persecute him. He is not always sure of the reality of these voices; I knew a patient who tested them by shouting obscene counter-insults and waiting for the blow which would inevitably follow if it was a human being whom he addressed; but he ran away from the voices nevertheless. Many voices may be heard and identified; they usually come from the air or the walls and are not attributed to bystanders. The patient is commonly terrified and is glad to seek asylum in a hospital or police station. A few patients have committed suicide; the voices often urge such a course. Hallucinations in other senses are uncommon, but cutaneous hallucinations may now and then occur. Sometimes there is a mixture of delirium and hallucinosis. Usually, however, the patient knows where he is and can talk connectedly. *Delusions* Patients, seeking to explain their experiences, develop delusions such as paraphrenics have, but do not during the acute attack hold to them with any great conviction. The danger of the condition, however, is that, instead of the usual full recovery after three or four weeks, the patient may become free of current hallucinations but still certain that they did occur earlier and, what is much worse, that the delusions which then began are well founded: the delusions persist, becoming more coherent and even systematized, and the condition is indistinguishable from a paranoid schizophrenic illness. These are mostly people prone to schizophrenia, in whom the alcohol has acted only as a contributory or provocative factor in the manifestation of a mainly constitutional disorder. A few patients pass from a hallucinosis into a Korsakow state, but this is rare.

(3)—Chronic Alcoholic Delusional States

Chronic alcoholics may become paranoid, as just indicated; they may, however, without passing through an acute hallucinosis, develop delusions of jealousy, which at first are only evident during intoxication but later pass, by way of constant suspicion and efforts to detect infidelity, into definite morbid beliefs, often very tenaciously held, which persist in the intervals when the patient is sober. He accuses his wife of adultery with neighbours or relations and attempts to extort a confession from her; he may treat her brutally, endangering her life. His diminishing potency, his sexual maladjustment, his bad conscience, and his wife's inevitable aversion from him when drunk may play a large part in the development of these delusions of jealousy, which can develop also in abstinent men during late middle life; alcohol and its effects cannot therefore be mainly blamed for the psychosis in all cases, even when there is a history of alcoholism. When the alcohol is mainly responsible, a short stay in hospital is usually sufficient to put an end for the time to these delusions, but they recur quickly when drinking is resumed.

There are other chronic alcoholics, never showing delusions or any definite psychosis, who deteriorate; along with the physical evidences of their addiction (see Vol. I, p. 284) they exhibit deficiencies of memory and judgement, laziness, indifference, facile euphoria, and lability of mood; failure to observe responsibilities, mendacity, gross lack of self-control, and general demoralization make them a burden to their families and to society at large.

(4)—Korsakow's Syndrome

Incidence

Symptoms

Confabulation

Polyneuritis

Pseudo-paresis

Prognosis

Alcohol is the commonest, but by no means the only, exogenous cause of Korsakow's syndrome. The condition is not so rare in women as is delirium tremens and may be complicated by arteriosclerotic or early senile dementing features; it is most frequently seen in middle-aged alcoholics. The outstanding symptoms are those of grossly disturbed memory; hence come fabrications, which more or less fantastically cover gaps in recollection (confabulation), and disorientation in space and time. Consciousness may be fairly clear, so that the patient can talk on familiar general topics without betraying his disorder to an uninformed listener. His judgement is bad. He is usually apathetic, or he varies between empty euphoria and morose irritability; he may get fat in his idleness, though some waste and go downhill rather rapidly. Recognizable polyneuritis is a common, but not invariable, concomitant. The condition is, in the main, only an extreme form of the mild dementia seen in many chronic alcoholics; it may develop insidiously out of this or supervene on an acute delirium or confusional episode. It is occasionally accompanied by the neurological symptoms (especially the ophthalmoplegia, pupillary changes, and sleepiness) of Wernicke's polio-encephalitis; these are the cases called alcoholic pseudo-paresis. Few patients recover completely from Korsakow's syndrome, but they may be able to meet most of the requirements of ordinary life, provided that they abstain from alcohol. Others, however, never improve, especially when there are vascular or other degenerative cerebral changes (see also p. 334).

(5)—Other Conditions

Some alcoholic conditions, e.g. mania a potu, are features of acute intoxication and depend largely on the patient's constitutional peculiarities; excitable, hysterical, and epileptic psychopaths are all prone to show cruder mental evidence of intoxication than are well balanced people; similarly those who have suffered a head injury, patients with cerebral vascular disease, and otherwise healthy people who are tired or convalescent from a severe illness, are unduly susceptible.

4.–DIAGNOSIS AND DIFFERENTIAL DIAGNOSIS

It is impossible to recognize an alcoholic psychosis from the mental state alone. A history of alcoholism is essential for this diagnosis, but in a typical acute hallucinosis or Korsakow state alcohol can be regarded as by far the most probable cause.

Differential diagnosis of delirium tremens

Delirium tremens may have to be differentiated from a schizophrenic excitement, an epileptic confusional state, general paralysis of the insane, and infectious fevers with delirium. The delirium, though due to alcohol, may be complicated by symptoms due to senile, vascular, psychopathic, or other previous disorder. Bromide intoxication must also be borne in mind (see p. 324).

Of acute alcoholic hallucinosis

Acute alcoholic hallucinosis may be wrongly diagnosed in a severe attack of anxiety occurring in an affective psychosis, especially in involutional patients. In not a few others, as Bleuler has insisted, an attempt to differentiate the condition from schizophrenia is vain, because the hallucinosis is a schizophrenic outburst provoked by alcohol.

Of Korsakow's syndrome

A Korsakow state must sometimes be distinguished from general paralysis of the insane, senile disorder, or cerebral arteriosclerosis. In these the memory disturbance is more gradually developed and characteristically limited to rather recent events; nor are confabulations so striking; but when there is doubt it is generally because a Korsakow state of other than alcoholic aetiology is present.

5.–TREATMENT

(1)—Preventive

Prevention of alcoholism

Individual prevention of alcoholic addiction and its effects is seldom practicable; there is no means of detecting potential drunkards. Social prophylaxis has in this century, and especially in the last two decades, worked effectively towards lessening alcoholic excess and therefore alcoholic insanity and alcoholic delinquency. This prophylaxis has been effected partly directly through legislation which made alcohol less easily available, partly through a change in social habits and outlook.

Supposed eugenic reasons have led in Germany to the inclusion of severe alcoholics among those to whom compulsory sterilization is applied; in two years 5,000 drunkards were sterilized under this law. There is not, however, any scientific ground for believing that alcoholic excess leads in human beings to transmissible damage to the germ-plasm, or that a predilection to alcoholism can be transmitted genetically.

Of alcoholic psychoses

The only prophylaxis of alcoholic psychoses lies in the effective treatment of alcoholics.

(2)—Symptomatic

The treatment of alcoholic psychoses is short-sighted, not to say futile, if it aims only at freeing the patient from all psychotic symptoms. If he leaves hospital with no discoverable signs of mental ill-health and then returns to his poison, a further psychosis is almost inevitable, and little has been gained by his treatment. His addiction to alcohol, much more than the dramatic episode which brings him to the psychiatrist, is the therapeutic problem. A further period of hospital treatment, after the psychosis has ended, is therefore advisable. This is not difficult to enforce if the patient has been certified during his psychosis, but it is better that he should stay voluntarily for at least six months than for him to be helped against his will. Less than six months' stay is unlikely to achieve much; it has been found, however, that 'the subsequent course with respect to drinking depends more upon the personality of the individual and the situations which he has to meet after leaving the hospital than on the duration of hospital residence', or, it may be added, the amount of psychological and social treatment he receives there. The latter, however, is indispensable; it is the medical equivalent of those procedures which, by a profound emotional disturbance (most often in the form of religious conversion), turn a drunkard into an abstainer. The emotional change effected by medical means is more gradual and is part of a re-educative psychotherapy, in which there will be alteration of the patient's habits and outlook in respect of much else besides alcohol (see Vol. I, p. 287). After the patient has left the institution, total abstinence is his only hope; he cannot remain a moderate drinker. Some patients are unhappily situated in this regard, their occupation making it very hard for them to be teetotal. They are wise to change their occupation if they can. The co-operation of the patient's wife in helping to arrange his life suitably at home is essential. With the best treatment available the prognosis for recovery from the habit is poor, especially in patients over forty. Statistics of recovery vary between a sixth and a third of the patients treated and depend on the types of alcoholic treated and the duration and thoroughness of the 'follow-up' inquiry.

Various procedures, such as oxygen injected subcutaneously or inhaled in high concentration (90 per cent oxygen, 10 per cent carbon dioxide), and injections of apomorphine hydrochloride, have been fashionable or seemingly efficacious in some hands, chiefly for acute intoxication (see Vol. I, p. 289).

Delirium tremens

During an attack of delirium tremens circulatory failure is the chief danger; sometimes cardiazol or digitalis is given from the outset for this reason. The patients must also be prevented from hurting themselves or wearing themselves out; continuous baths are better than drugs for this sedative purpose; moist packs were formerly recommended but are unsuitable, because they are also a form of restraint and may increase the patient's anxiety and circulatory disturbance. There is little advantage in giving drugs to induce sleep; they will not have this effect, except in dangerous doses. Some writers have found it helpful to give moderate quantities of insulin during the delirium; lumbar puncture is much employed by others. In all alcoholic psychoses alcohol should be withheld absolutely from the beginning; 'tapering off' is unnecessary.

Acute alcoholic hallucinosis

Polyneuritis

Acute hallucinosis should be treated in an appropriate hospital or ward, never at home; there is no specific treatment. In any alcoholic condition with demonstrable neuritis it is rational to give vitamin B_1; the results, however, are not so satisfactory as experimental studies on animals and some reported work on human beings would suggest; the same may be said of nicotinic acid.

Paranoid and jealous alcoholics cannot be lightly allowed to leave a mental hospital as soon as their delusions have subsided after enforced abstinence from alcohol.

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VI.—PRE-SENILE AND SENILE PSYCHOSES

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1.—INTRODUCTION

1324.] Mental illness occurring in the senile period, when the physiological and psychological powers are wearing out, is a common phenomenon. The involutional period grades into the senile period, which arbitrarily may be said to occur from sixty-five years onwards. It may be asked why some people become old more prematurely than others, and why, as a general rule, men become old sooner than women. The respective reasons may be a strong family predisposition towards premature senility and the fact that men are more exposed than women to the stress and strain of everyday life and more involved with alcohol, syphilis, and other deleterious agents.

Senile period

Senility and senile psychosis are characterized by a primary change affecting the cerebral tissue and not necessarily associated with or dependent on arteriosclerosis, although arteriosclerosis may be present. It was thought that morbid changes in the brain explained the origin and development of senile states, but Rothschild pointed out that destructive lesions of the central nervous system produced merely negative effects or loss of function, whereas the positive symptoms were due to the activity of the preserved portions of the organism and represented its attempt at adaptation to the altered situation. According to this hypothesis the delusional systems or the considerable affective changes which so often occur are attempts at compensation for what has been destroyed.

Characteristics of senility and senile psychosis

2.–PRE-SENILE PSYCHOSES

Although Alzheimer's and Pick's diseases occur in the pre-senile period, they are not uncommonly confused with senile degeneration.

Alzheimer's disease and Pick's disease

(1)—Alzheimer's Disease

Critchley has given a detailed account of the clinical and pathological features of Alzheimer's disease (see Vol. I, p. 354) which sums up present knowledge. It is evident, however, that the characteristic histopathological changes described by Alzheimer may occur in a greater number of disorders than was at first supposed, and that the aetiology may be varied. The cases, for instance, described by Malamud and Löwenburg, by Hallevorden, and by Rothschild and Kasanin are of great interest. The clinical feature which I would emphasize is the consistency with which childish euphoria takes the place of the stage of irritability.

(2)—Pick's Disease

(*a*) *Definition*

Pick's disease is a rare form of organic brain disease due to a circumscribed atrophy of certain portions of the cerebral cortex, especially the frontal and temporal lobes.

(*b*) *Aetiology*

This condition usually affects people between the ages of forty and sixty years, but Grünthal reported cases occurring earlier than forty and later than sixty years.

Incidence

Causation The aetiology of this disorder is obscure, but present evidence emphasizes its heredo-degenerative nature. Grünthal, for instance, reported its occurrence in two brothers and in two generations of a family. In other cases there has been distinct evidence of neuropathic family traits.

(*c*) *Morbid Anatomy*

Macroscopical appearances Macroscopically, the brain shows a circumscribed atrophy involving especially the frontal and temporal lobes; there may also be a shrinkage of the corpus striatum. Grünthal (1936) stated that atrophy of the occipital lobe had not yet been observed with certainty. The atrophy is usually confined to one half of the brain, usually the left, in contrast to the symmetrical involvement in Alzheimer's disease and other senile states. The motor cortex and cerebellum are not usually affected.

Microscopical appearances Microscopically, the nerve cells in the third layer of the cortex disappear first, and their place is taken by neuroglial overgrowth; the cells in the first three cortical layers are more intensely involved than the others. Many of the ganglia become swollen—'ballooned'—and stain deeply with silver. The chromatin substance of many of the nerve cells disappears, and the nucleus becomes displaced to the periphery of the cell and is pale and vacuolated. Occasionally, senile plaques and Alzheimer's tangles may be present, but in no case are they a conspicuous feature of the disease. The white matter may also show an early atrophy.

(*d*) *Clinical Picture*

The clinical picture is obscure, but notable contributions have been made by Kahn and Thompson, and by Grünthal (1936). Kahn and Thompson distinguished two clinical types: one characterized by dementia and aphasia, the other by dementia alone.

Onset The onset may be acute or insidious, but more usually the latter, and the symptoms are characteristic of organic brain disease in general, i.e. a disorder of character, intellectual function, and affect.

Change of character The patient's standards become changed, he is careless, dull, and slow in understanding and responds in an inadequate manner to matters sad or joyful. There are mental dullness, a lack of initiative even in regard to acts of personal cleanliness, and a fluctuating disorder of attention. As a rule it is only much later that a real memory disturbance, either for remote or for recent events, can be demonstrated.

Later changes As the disease progresses, conspicuous features occur, such as great emotional lability, impulsive laughter and crying, and complete disorientation for time, place, and person. Restless activity is not uncommon, his actions are more or less stereotyped, and he is childlike, wanders about aimlessly, and cannot be influenced by logical explanations. If interfered with, he becomes irritable, impulsive, and suspicious. Almost inevitably, however, apathy occurs, and any action is almost purely reflex and instinctive. Speech may disappear entirely or be limited only to a few words or set expressions. Epileptiform attacks, although not unknown, do not commonly occur. Aphasic, alexic, agraphic, and dyspraxic symptoms are usually present.

The terminal picture is one of great mental and bodily enfeeblement; the patient becomes bedridden, suffers from loss of sphincter control, and usually dies from some intercurrent affection.

(*e*) *Course and Prognosis*

The illness as a rule runs a prolonged course even up to fifteen or twenty years.

(*f*) *Differential Diagnosis*

Clinically it is difficult and sometimes impossible to differentiate Pick's disease from Alzheimer's disease. The two conditions develop at the same time of life, run an almost identical course, and have more or less similar clinical symptoms. It has been suggested that the memory disorder in the Alzheimer group occurs much earlier and is more progressive; but that is not a very accurate guide. The only basis on which it seems reasonable to make a distinction is the belief that Pick's disease is a heredo-degenerative affection. The two following cases may fall into such a category.

A single woman, 66 years old, admitted to the Royal Edinburgh Hospital for Mental Disorders in 1933, had shown for sixteen years previous to admission signs of incipient mental incapacity. She was irritable and cantankerous, and her memory showed a progressive decline, so that ultimately she could not name objects, had difficulty in understanding spoken speech, lost all her social accomplishments, was unable to dress or feed herself, and now had lapsed into a state of complete childishness. Her blood-pressure was 124/76.

Her hereditary history is of interest. Her paternal grandmother was blind for some years before her death; a paternal uncle had a 'shock'; her father lost his sight when 70 years old; and her mother suffered from senile dementia.

A widower, 62 years old, had shown, for seven years previous to his admission to the Royal Edinburgh Hospital for Mental Disorders, a progressive loss of memory. He was indolent and apathetic and behaved peculiarly. His speech became reduced to one or two stereotyped phrases, e.g. 'Cheerio, Jimmy' or 'I love you fine'. He had little or no understanding of spoken speech; he showed dyspraxia. There was no evidence of arteriosclerosis.

Pathologically, however, Alzheimer's and Pick's diseases appear to be separate and distinct. It may be that, with the development of encephalography and other specialized methods, knowledge of these obscure organic disorders will in the near future be greatly augmented.

3.—SENILE PSYCHOSES

(1)—Introduction

Simple senile deterioration

The senile psychoses include simple senile deterioration and senile delirium. The former is a progressive mental deterioration showing all the characteristic changes of the organic reaction type, e.g. a change in character, affect, and intelligence; the defect in comprehension and memory is particularly outstanding.

Senile delirium

Senile delirium is an acute process characterized by the usual symptoms of delirium, e.g. an acute hallucinosis, usually visual, with complete disorientation and an accompanying affect of fear. Such a reaction is often precipitated by injury, especially by head injury, by any toxic process, or after operative interference, e.g. prostatectomy and excision of a cataract. Often the delirium is purely transitory and may quickly resolve, but sometimes it may be considerably prolonged; nursing may present great difficulty, and death may occur from exhaustion or from pneumonia.

(2)—Morbid Anatomy

Macroscopical appearances

The changes in the brain are often not very conspicuous and may not differ greatly from those in the brain of a normal person dying at an advanced age. Usually the cranium and dura mater are thickened, the pia mater and arachnoid opaque, and the frontal and temporal tips tacked down by adhesions. The brain may be shrunken and show a decrease in weight of 100 to 200 grams. The atrophic changes are especially marked in the frontal and prefrontal areas, but in some cases the changes in the convolutions are diffuse and accompanied by widening of the sulci and dilatation of the ventricles. The walls of the ventricles show granulations. In most cases a mild degree of arteriosclerosis is present with areas of cerebral softening.

Microscopical appearances

The most characteristic feature is the involvement of the nerve cells. There is a decrease in number, the layering of the cortex becomes changed, and many cells are so altered in appearance that the cortex presents a washed-out appearance. They may show a considerable increase of lipoid material. The third layer of the cortex usually shows the most pronounced changes. There is a compensatory neuroglial increase.

Senile plaques

Senile plaques are present in all cases. They consist of a combination of neural and glial elements, which stain deeply with silver. They vary considerably in frequency and size and, when many are present, may merge into one another, producing 'a plaque-like infiltration of the tissues'. The extent of the plaque involvement is a rough indication of the degree of senile dementia. The plaques occur throughout all the layers of the cortex, but the third layer is most often involved. They are found also in the hippocampus (Ammon's horn), the thalamus, the cerebellum, and the subcortical white matter.

Alzheimer's tangles

Alzheimer's tangles (see Vol. I, p. 355) were found by Rothschild in all but two of twenty-four cases. They were most often present in the hippocampus and hippocampal gyrus, but in seven cases they were distributed throughout the cerebral cortex.

(3)—Clinical Picture

(a) *Mental Characteristics*

Onset

At the onset there are narrowing of interest, conservatism, and lack of elasticity which only become pathological when they lead to a lack of judgement and foresight. There arise a stagnation of thought and an inability to accept a new point of view. Attention, interest, and concentration fail, with the result that an apparent memory defect occurs for events which happen from day to day. In some cases this may merge into negativism. The memory defect is progressive and is termed anterograde amnesia. The days, the months, and the years are forgotten, and things seen, heard, and read about soon pass into oblivion. In contrast the memory of the events of early childhood is often well retained. During the process of decay attempts may be made to fill the memory gaps by fabrications or false memories.

Anterograde amnesia

Associated with this failure there is usually complete disorientation for time, place, and person, particularly at night-time. Nocturnal restlessness and sleeplessness then become most difficult symptoms to cope with. The patient may insist on getting out of bed, saying that he is going to his own home, even although he is living there, and, when opposed, he may become extremely irritable, resistive, and suspicious. He may insist on wandering from one room to another and may question the authority of those who are in charge of him. He is so lacking in insight and judgement that he requires supervision night and day. In due course he becomes totally incapable of looking after his business or personal affairs and may require to have a Receiver or Curator Bonis appointed. It may be possible to care for him under home conditions even in such a disordered mental state, but, when character and affective or delusional states become prominent, some other provision is necessary, e.g. a nursing home or mental hospital (see also MENTAL ILLNESS, LEGAL ASPECTS, Vol. VIII, p. 564).

Disorientation

Restlessness

One of the most distressing changes which occur is a hyper-excitability of the sexual functions, resulting in acts of gross indecency, not uncommonly towards children, no doubt a compensatory reaction for a failing function. The patient may become spiteful and avaricious and may be guilty of acts which are foreign to his natural disposition. Pride in his personal appearance is lost, and he becomes untidy in his personal habits and sometimes leads the life of a recluse.

Sexual activity

Change of character

The change in affect is towards apathy and indifference. The patient becomes self-centred, the claims of his nearest relatives mean nothing to him, but, if annoyed or frustrated, his indifference may turn into fits of irritation, which are violent but short-lived. It is not usual in such a condition to have systematized delusions, and any delusions present are unsystematized and more generally of a persecutory than of a grandiose or depressive nature, although all types may occur. Hallucinations are not common and, when present, are not uncommonly caused by too liberal medication, e.g. bromides.

Change in affect

The end-picture is one of regression to a childish or an infantile level with all the mental powers in complete abeyance.

Regression

(*b*) *Physical Characteristics*

Some retain their general physical health to a remarkable degree, but others show a physical failure parallel to the mental impairment. They become thin and shrunken, the skin becomes dry, the hair loses its lustre and falls out, and endocrine glands fail to function. Not uncommonly there are complaints of headaches, dizziness, and frequency of micturition, and epileptiform or apoplectiform attacks may occur with residual aphasic and apraxic disturbances. The speech is tremulous, slurring, and incoherent; the writing is shaky, and words are mis-spelt; there are tremors of tongue, hands, and facial muscles, a shuffling gait, exaggerated or diminished tendon-reflexes, and incontinence of bladder and bowels. In the latter stages the patient may have to be fed and attended to like a helpless infant.

4.–TREATMENT OF PRE-SENILE AND SENILE PSYCHOSES

Prophylaxis

Treatment should be mainly preventive and palliative. Preventive methods consist in attempting to regulate the life of the person who is known to have come from a predisposed stock and in advising the avoidance of all excess either in mental or in physical work. With careful regulation of the person's life, relieving him of his special worries and arranging for suitable meals and sufficient sleep, it is surprising how much improvement in conduct will occur.

Institutional treatment

It is important to try to obviate the necessity of removal to a mental hospital. The question, however, of such treatment depends essentially on the economic situation and on the severity of the symptoms. If the relations can provide special nursing, many patients, even although they are seriously affected, can be cared for either in their homes or in specialized nursing homes, but otherwise the help of the mental hospital may be required, particularly when the patient is restless at night-time or is suspicious and has delusions, or when a considerable change in character has occurred. All such patients are much more easily nursed and cared for by strangers than by their own families. The orderly discipline of hospital life, the freedom from friction, and the general nursing and medical supervision and treatment may have a most beneficial effect.

The patient must have his meals at regular times, and his food should be easily assimilable. The function of bladder and bowels must be regulated, adequate exercise arranged, and accidents prevented, e.g. falling from bed and sustaining fractures. *Insomnia* Perhaps the feature which requires the most careful treatment is sleeplessness. A great deal can be done to obviate this by providing a comfortable bed and by arranging suitable diet, but drugs may be necessary. *Bromide* The use of bromide should be carefully supervised owing to the risk of producing bromide intoxication with delirious symptoms. This is particularly apt to occur in cases in which elimination is defective. *Paraldehyde* In most cases paraldehyde in doses of from 1 to 2 fluid drachms (each fluid drachm should be diluted to one fluid ounce with water) proves extremely effective; or, if paraldehyde

Barbiturates

Hyoscine and morphine

is objected to, a small dose of any of the barbiturate preparations may prove satisfactory, e.g. soluble barbitone 5 grains; barbitone 10 grains; or phenobarbitone in $\frac{1}{2}$ to 1 grain doses. In cases of great emergency a hypodermic injection of hyoscine hydrobromide $\frac{1}{100}$ grain with morphine sulphate $\frac{1}{6}$ grain acts almost without fail. Opium and its derivatives I have now almost entirely abandoned.

In the later stages great care must be taken to prevent the development of bed-sores.

5.–CEREBRAL ARTERIOSCLEROSIS

(1)—Aetiology

Incidence

Arteriosclerotic changes affecting the brain are extremely common and usually appear in persons over fifty years of age; in specially predisposed people cerebral arteriosclerosis may occur at an even earlier age.

Relation to general arterio-sclerosis

Cerebral arteriosclerosis need not necessarily be accompanied by a general arteriosclerosis, and a sclerosis of the peripheral vessels may be present without affecting the cerebral vessels. Neuberger found peripheral arteriosclerosis in only 10 per cent of cases of cerebral arteriosclerosis.

Heredity

Other factors

There is no doubt that hereditary involvement or familial predisposition is particularly strong, and alcoholism, syphilis, hard physical and mental work, and infective agents of all kinds are predisposing factors. The condition in most cases does not lead to care and treatment in a mental hospital, but in severe cases, particularly those with focal lesions, such treatment may be imperative. Approximately 15 per cent of first admissions to mental hospitals are due to this condition.

(2)—Morbid Anatomy

In most cases the brain shows a slight degree of atrophy of the convolutions with thickening of the brain membranes, and occasionally a subdural haemorrhage. The thickening of the large arterial vessels is readily seen, but it is traditional to describe the microscopical appearances in terms of (i) atheroma, (ii) colloid-calcareous arteriosclerosis, and (iii) arterio-capillary fibrosis.

Atheroma

(i) In atheroma the circumference of the vessel is not affected uniformly but has a 'signet-ring' appearance. The degenerative process attacks the media and elastica; the intima proliferates at first but soon degenerates, and as a result a haemorrhage occurs and causes a large focal lesion.

Colloid-calcareous arterio-sclerosis

(ii) In colloid-calcareous arteriosclerosis the vessel becomes obliterated, and an area of softening occurs due to the loss of blood-supply.

Arterio-capillary fibrosis

(iii) In arterio-capillary fibrosis the small vessels supplying the nerve cells are involved.

According to the deficient blood-supply to the brain, reactions occur in the nervous tissue, giving rise to arteriosclerotic brain atrophy, subcortical encephalitis, perivascular gliosis, and senile cortical devastation of the nerve cells.

(3)—Clinical Picture

(a) *Mental Characteristics*

In the milder group of cases, e.g. those in which the smaller cortical vessels are affected, the patient complains of lack of concentration, easy fatigability, and tiredness. Work which was formerly a pleasure becomes a source of irritation; there are confusion of thought and transitory clouding of consciousness. Fear and apprehension lead to depression with agitation and a sense of something impending. What seems to be a hypochondriacal element appears. The depressive features become prominent in many instances, but transitory emotional outbursts, e.g. fits of crying or laughter, are outstanding. If the element of irritation is in the forefront, violent fits of rage occur sometimes. Accompanying these changes there is disturbance of memory for recent events, names, and places, and confabulations may take the place of the gaps in the memory.

Pseudo-bulbar paralysis

As the disease progresses, all the above-mentioned symptoms become more prominent, and transitory delusional and even delirious states may occur. In the more severe cases, e.g. those in which the large vessels are affected, the first onset may be an apoplectiform or epileptiform seizure with consequent aphasia or other focal symptoms. The first seizure may be followed by fair recovery with but a few residual symptoms, but the attacks tend to recur, and first one side and then the other side of the body may be affected and give rise to pseudobulbar paralysis. The mental symptoms then become very pronounced both in the affective and intellectual fields. The lability of mood is such that the patient may be made to laugh or cry on the slightest provocation, but the prevailing tone is of depression often with considerable agitation. Ideation is disturbed, and delusions of persecution, poverty, and sometimes, but more rarely, of grandeur may be expressed. The memory defect and disorientation become conspicuous, and there occurs what has been termed 'a dipping of consciousness', an ability to remember one minute and almost total forgetfulness the next. The personality is well retained throughout the greater portion of the illness, but later on childishness and considerable deterioration occur with nocturnal restlessness and a suicidal tendency.

(b) *Physical Characteristics*

Headache, dizziness, and tinnitus occur and are usually associated with paraesthesiae, e.g. tingling affecting the extremities. The seizures which occur are followed by paresis or paralysis of the limbs, disorder of the emissive and receptive functions, and all types of apraxia according to the site of the lesion. Normal blood-pressure does not rule out the diagnosis of cerebral arteriosclerosis. In slightly more than half the cases the blood-pressure is raised. A surer sign of cerebral arteriosclerosis is sclerosis of the retinal vessels (see Vol. V, p. 225). The cerebrospinal fluid shows a slight increase of globulin and cells.

(4)—Course and Prognosis

When the large cerebral vessels have not been affected, the patient, with care and guidance, may be preserved for years and may maintain a fair degree of efficiency. Even patients who have suffered from serious apoplectiform or epileptiform seizures may make good readjustments, and many of them, after they have been treated in a mental hospital, can return to their homes. On the other hand, the eventual prognosis is poor, because a recurrence of symptoms is the rule.

(5)—Differential Diagnosis

The differentiation of cerebral arteriosclerosis from senile dementia is sometimes most difficult, but the question is perhaps more academic than practical; the two conditions may co-exist. As a general rule arteriosclerotic states begin at an earlier age, run a more tempestuous course, and are accompanied more often by serious subjective and objective physical symptoms. Involutional melancholia and hypochondriacal delusional states may occasionally present difficulties of differentiation from cerebral arteriosclerosis, but a careful physical examination should make the diagnosis clear.

(6)—Treatment

Treatment is symptomatic and palliative. Rest in bed, regulation of the bowels, careful dieting, and the control of sleeplessness are the chief points. The provision of a special nurse or a suitable companion is often a great help, because exercise can be carefully regulated and simple work instituted. Paraldehyde or the barbiturates in small doses are usually effective in producing sleep.

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VII.–TRAUMATIC PSYCHOSES

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Reference may also be made to the following title:

CONCUSSION AND COMPRESSION

1.–DEFINITION

1325.] Trauma may play a part in the causation of mental disorder in many ways. Sudden injury, especially if associated with severe pain and the fear of death or disability, constitutes an emotional shock which even in a stable person may produce a state of anxiety and tension lasting for many hours. In the sensitive individual the reaction may be more intense and of longer duration, and in persons of an affective or schizophrenic disposition the traumatic emotional reaction may develop into an illness of corresponding type and psychotic degree. Physical disability resulting from trauma and the anxiety arising from it may in a comparable but less direct fashion lead to serious mental disorder, especially when there is dispute over compensation.

Limitation of term

Although trauma may be in these ways the deciding factor in the causation of mental disorder, the form of the illness differs in no respect from that of non-traumatic origin. It is therefore best to classify such cases under the appropriate type of mental reaction and to reserve the term traumatic psychosis for mental disorder following injury to the head of a kind or degree which may be proved or assumed to have involved the brain, and in which it is reasonable to suppose that the symptoms are directly due to the cerebral injury.

Distinction between psychosis and neurosis

The term psychosis generally denotes a major degree of mental disorder as opposed to a minor disorder or neurosis: the distinction is a matter of convenience. In this article Mapother's suggestion will be adopted, that such mental abnormalities be called psychotic into the character of which the patient at the time lacks insight, and which, if sufficiently prolonged, would have justified certification.

2.–ACUTE TRAUMATIC PSYCHOSIS

This term describes mental disorder of the organic type resulting from and immediately following cerebral injury, without any clinical evidence to suggest gross focal damage or infection, e.g. meningitis, as the cause. It includes traumatic stupor, traumatic delirium, traumatic confusional states, and states of post-traumatic automatism with amnesia.

Aetiology and morbid anatomy

Changes in brain

Nerve cells

The patient who lives long enough after a head injury to show symptoms of mental disorder other than stupor almost always recovers, at least with his life. There is therefore little opportunity for correlation of clinical symptoms with cerebral pathology. Occasionally patients recovering from traumatic mental disorder die of other injuries or disease, and in them it is common to find contusion and laceration of the brain, especially at the frontal and temporal poles. Areas of haemorrhage visible to the naked eye may be scattered throughout the brain, brain-stem, and cerebellum; smaller haemorrhages may be seen under the microscope (see Vol. III, p. 356). Alterations have also been observed in the structure and staining reactions of the nerve cells, myelin, and neuroglia. These changes may be diffuse or scattered over large areas and are not confined to the areas of haemorrhage.

One of the best recorded cases is that published by Rosenhagen of a man aged forty-five, without a history of previous mental instability, alcoholism, or syphilis. After a fall from a scaffold he developed a traumatic psychosis and, without recovering from this, died six months later in a state of exhaustion aggravated by injuries received from a second fall, which resulted from his mental disorder but in which there was no head injury. Necropsy showed yellowish discoloration of the right temporal pole, as evidence of healed contusion, and remnants of blood-clot in the meninges. Macroscopically sections of the brain did not present any abnormal changes, but special methods of staining revealed numerous microscopic irregularities in the cerebral cortex due to loss of nerve cells. This loss was diffuse and affected all the laminae. Many of the remaining nerve cells showed lipoid degeneration and morbid changes in the nuclei. The glia cells in these areas showed lipoid inclusions, and the smaller vessels were surrounded by cells containing lipoid and blood pigment.

It is not permissible to assume that changes of this kind are always present in the brains of patients who recover.

One of the most striking features of the acute traumatic psychosis is the complete recovery which sometimes occurs in a case in which the illness has been of the most severe degree and of many months' duration. This has led to the hypothesis that increased intracranial pressure from oedema is the cause of the symptoms. Measurement of the intracranial pressure by lumbar puncture, however, shows that in many cases of the most severe traumatic psychosis the pressure is normal.

Possible effect of increased intracranial pressure

Possible effect of subarachnoid haemorrhage

It has been suggested also that subarachnoid haemorrhage, which is usual in severe head injuries from laceration of the meningeal or cortical vessels, might be the important factor in causing the mental disorder, for it is well known that in subarachnoid haemorrhage of non-traumatic origin delirium and confusion may be prominent symptoms. This hypothesis also is unproved. Some patients with severe mental disorder show from the first little or no blood in the cerebrospinal fluid. The pathological basis of the acute traumatic psychosis is therefore still uncertain. It seems probable that it is wide-spread direct injury to the nerve cells and fibres of a kind which is, within very wide limits, completely reversible.

Fracture of skull

Although a fractured skull is often associated with an acute traumatic psychosis, there is no evidence to suggest that the fracture is of any causal significance unless it adds the factor of infection.

Clinical picture

The acute traumatic psychosis is of the organic reaction type. Indeed in its various phases, the symptoms at any moment may be indistinguishable from those of other diseases belonging to this group, e.g. alcoholic intoxication or encephalitis. It is the time sequence and evolution of the symptoms in relation to the injury which give to the acute traumatic psychosis its individual features.

Concussion

Severe cases

'Cerebral irritation'

In the simple case of so-called 'concussion' the immediate result of diffuse injury is a brain the functions of which are reduced often to the lowest levels compatible with life. There is a gradual return of function from the lowest to the highest levels. The recovery in mild concussion is rapid and the patient may be himself again (i.e. with the highest levels of function restored) in a few minutes. In the more severe cases the initial phase of flaccid coma, which is characteristic of concussion, is followed by one of stupor with negativism, and this again by a phase of excitement and confusion ('cerebral irritation'). This is usually followed by a phase during which the patient may behave normally at an automatic level, although when he is questioned he may prove to be disoriented and afterwards has no memory of what he has been doing. A sequence of this kind lasting a few hours is common; after a more severe injury it may last several days.

Sometimes, presumably as the result of the same kind of injury of a more severe degree, the process of recovery may be long drawn out, occupying a period of weeks or months. When the mental disorder is of brief duration it is usually spoken of as an effect of concussion; if it is sufficiently protracted it is called an acute traumatic psychosis. The distinction is arbitrary, but a patient who presents symptoms of psychotic degree for more than forty-eight hours after the injury may be assumed to be suffering from an acute traumatic psychosis. In such cases, as a rule, following the initial brief coma there is a period of deep stupor, during which the patient is apt to resist any attempt to disturb him, even for purposes of feeding and nursing. This may last in severe cases for three or four days.

Stages in acute traumatic psychosis

Traumatic stupor

The next stage is usually delirium. The patient is restless, noisy, incoherent, hallucinated, apparently unaware of his environment, and inaccessible to conversation. There may be fluctuation between delirium and stupor, and the delirium is often worst at night. At his worst the patient is wet and dirty and has to be fed. In the early stages the temperature is usually raised. The phase of traumatic delirium may pass quickly or may persist for days, sometimes for weeks and, while it continues, there may be occasional relapses into stupor for as long as a day or two at a time. Occasionally the stage of delirium is absent, and the patient emerges from the state of stupor dazed, bewildered, apathetic and sometimes mute.

Traumatic delirium

Duration

In the next stage, although consciousness remains clouded, the patient gradually becomes more accessible, and it is possible to engage him in conversation for short periods. He is quieter and more controlled, able to feed himself, and no longer incontinent. He remains, however, confused and disoriented. There is often a far-reaching amnesia, so that he is apt to interpret his surroundings in terms of long past experience. For instance, a man aged 29, a motor salesman who had previously held other posts, gave his age as 19 and thought that the ward in which I saw him was part of the nautical college where he had been at that age. Memory and judgement are grossly impaired, and the patient has no insight into the fact or nature of his illness. Perception is imperfect and slow, and the capacity for synthesis of perceptual data is lacking, so that complex pictures, for instance, are not understood. The same difficulty is apparent in the comprehension of the spoken, and especially the written, word. Simple commands or written orders may be correctly performed, but if a sentence contains two separate requests the two ideas are confused. Frequently, also, related but irrelevant material intrudes into and disturbs the process of thought formation, so that the patient's responses may be unintelligible unless the connexion can be followed. For example, a man to whom the written request was given 'Take off your glasses and hand them to me', after puzzling over the sentence for some time looked at his hands and said 'I haven't got any'. Asked to read the sentence aloud, he read 'gloves' instead of 'glasses', the misreading being probably due to the association of 'hand' with 'glove' and the consequent intrusion of the latter word. Perseveration is often prominent in both action and speech.

Traumatic confusional state

An idea or a word once in the mind cannot be immediately got rid of but persists in such a way as to impress and distort what follows. A patient in this state, for example, shown some apples, named them correctly but, when next shown a jug of milk, called it an 'apple can' and said of the gauze cover to the mouth of the jug that it was 'an apple cleaner to keep dirt out of the apple can'.

The mood in this stage is often elevated, spontaneous talk plentiful, and motor activity increased. The patient is apt to exaggerate and boast in a childish way. Sometimes the reverse is seen, a tearful, depressed, and bewildered state. Faced with any task beyond his capacity, the patient readily becomes querulous and irritable. He shows as a rule no special preoccupations but, owing to his lack of insight, may resent interference with his freedom, pestering those around him to allow him up and out. Occasionally misinterpretation of the surroundings may lead to impulsive violence, as in the case of a young man under my care who, seeing a male nurse walk unexpected and unannounced into the room where he lay in bed, took him for an intruder and felled him to the ground with a blow on the head from a heavy flower vase. *Duration* This stage of confusion may be brief, or it may last for weeks, in exceptional cases for several months—and yet pass.

Traumatic amnesia and automatism

Korsakow state

In the next stage, the clouding of consciousness and confusion having apparently subsided, a gross defect of memory, especially for recent events, persists, with a tendency in many cases to confabulation. The clinical picture is thus not unlike that of Korsakow's psychosis. Pfeiffer and Schilder regard the Korsakow state as an almost invariable sequel to that of confusion in the process of recovery. At this level of function perception and thought are clear, but retention remains defective. Mapother, on the other hand, regards the Korsakow picture as an inconstant feature of the traumatic psychosis, probably depending upon focal injury.

The patient in this state may, under sheltered conditions, show little abnormality. His behaviour may be quiet and reasonable in an automatic way. The mood also may be normal, though there is still a tendency towards elation, and he may be more talkative than usual. When he is questioned or encouraged to talk, he appears imperfectly oriented for time, place, and person and is unable to retain the memory of recent events. *Confabulation* As a rule he endeavours to fill the gaps of memory with plausible stories cheerfully told, which he seems genuinely to believe. This tendency to confabulate is often retrospective and may lead to the most fantastic accounts of the accident.

In my experience, examination in this so-called Korsakow phase of the traumatic psychosis has generally revealed some residual element of confusion. Schilder, however, states that this may be absent and thinks that confabulation may still be present when the memory for recent events has come back to normal. Insight and judgement are still impaired.

Duration

This phase also varies in duration, lasting days, weeks, or occasionally months. Recovery, though gradual, may be quite rapid. It may be regarded as complete when the patient has continuous insight into the nature of his illness and can manage his own affairs.

Variations in sequence of phases

This sequence of stages is not invariable and, when it occurs, the distinction between each stage is not clear cut. In particular, the earlier stages may be absent or, more probably, so brief that they are negligible. Thus, a patient regaining consciousness after concussion may be confused without any preliminary stage of delirium, or he may simply emerge from unconsciousness into the state of amnestic automatism.

Course and prognosis

Risk to life

The prognosis as to life is generally good. If the stage of delirium is protracted, there is danger of death from exhaustion or from intercurrent infection, especially in elderly or debilitated persons, and the greatest risk is in the first week or two of the illness, when delirium is most severe. I have, however, seen a woman aged sixty-five in whom the delirious state persisted for six weeks with a fatal issue. In the patients who survive, recovery from the acute traumatic psychosis is almost invariable, even though the illness lasts many months. The longest record I have was in a man aged sixty-seven who still showed gross memory defect with some confusion fourteen months after his injury, but in a month from that time was quite clear, and, though now showing a slight residual deterioration of intellect and personality, has for two years managed his own affairs and led a normal life. Patients who do not recover have probably, in addition to the diffuse injury, gross focal damage, e.g. to the frontal lobes.

Duration of the psychosis

Residual mental defects

Although with the termination of the amnestic phase the acute traumatic psychosis may be said to have ended, it does not follow that the patient has completely recovered from the mental disorder. The return of function at the higher levels almost always reveals defects of the kind which generally accompany the early stages of an organic dementia. Memory, especially for recent events, remains impaired. Judgement is poor. The patient complains of difficulty in concentration and is easily fatigued by physical or mental effort. Often he sleeps badly and is troubled by headache and giddiness. Defective inhibition reveals the less desirable traits of his personality and the underlying trends of his mood. He is, though he may not realize it, not the same man but a slightly worse one. All these defects are aggravated by fatigue, infection, or intoxication; alcohol even in moderate quantity may produce a pronounced effect.

The tendency towards recovery may continue at a steadily diminishing rate for two years. The great majority of patients are mentally well enough long before this to return to their ordinary occupations, but many show permanent traces of the injury in various forms, such as slight alterations in the personality, subjective slowness of thinking and difficulty in remembering, increased susceptibility to fatigue, and intolerance of alcohol. Permanent incapacity for work from mental disorder after an acute traumatic psychosis is uncommon.

Effect of age on prognosis

The outlook is least favourable in elderly people, especially if there is evidence of arteriosclerosis, and in patients with a past history of severe head injury. In children there appears to be a special liability to demoralization with associated behaviour disorder of the kind more often seen as a sequel of epidemic encephalitis. Changes of any kind which persist after two years are likely to be permanent. Sometimes in elderly persons with cerebral arteriosclerosis, after partial recovery a progressive secondary dementia sets in, with permanent deterioration.

Differential diagnosis

Diagnosis from alcoholic intoxication

With a history of head injury there is usually no difficulty in diagnosis, unless there is a suspicion that the patient was drunk at the time of the accident, when the distinction between traumatic and alcoholic stupor and delirium may for a time be in doubt. Failure to recover in the course of forty-eight hours would determine the diagnosis in favour of trauma. Greater difficulty may arise in a chronic alcoholic who sustains a head injury and passes into a delirious state, for delirium tremens may be precipitated by head injury, and its symptoms can hardly be distinguished from those of traumatic delirium. The course of the illness in the two diseases also is similar. The differential diagnosis may be impossible at the time, but in retrospect the duration of the delirium in relation to that of the stages of recovery is longer in the alcoholic than in the traumatic cases.

Delirium tremens

Acute traumatic psychosis may develop after a head injury without fracture of the skull and sometimes without visible evidence of head injury. Occasionally, if no witness of the accident is available and the patient is found in a delirious or confused state, the diagnosis presents great difficulty. Even if blood is found in the cerebrospinal fluid, the diagnosis from spontaneous subarachnoid haemorrhage remains uncertain.

From subarachnoid haemorrhage

From meningitis

In compound fractures of the skull the possibility of meningitis as a cause of delirium and confusion must be considered. The question can be settled by examination of the cerebrospinal fluid.

From meningeal haemorrhage

If at any stage there is regression in the symptoms with a steady or fluctuating progress in the direction of stupor, and especially if this is associated with development of focal signs, such as a unilateral dilated pupil or a hemiparesis, meningeal haemorrhage, epidural or subdural, should be suspected.

Treatment

In the delirious stage the main problems of treatment are the control of restlessness and adequate nutrition. Continuous skilled nursing is essential. Sedatives are nearly always needed and should so far as possible be reserved for the night. A dose of chloral hydrate 20 grains, with potassium bromide 20 grains in half a fluid ounce of chloroform water may be given in two fluid ounces of water and may be repeated in four hours if necessary; or one of the barbiturates, such as soluble

Sedatives

barbitone 10 grains or nembutal 3 grains; or paraldehyde 2 to 4 fluid drachms in five fluid ounces of water. It is a good plan to change the drug occasionally in order to minimize the risk of cumulative intoxication by any one. If the patient refuses drugs by the mouth, it may be necessary to give morphine sulphate by injection in a dose not larger than $\frac{1}{4}$ grain for an adult. In the violent stage of delirium it is sometimes necessary to repeat this dose after four hours. Hyoscine is best avoided owing to its tendency to increase confusion.

Feeding

Stupor in the early stages necessitates tube feeding; the best device is a soft rubber catheter passed through the nose into the stomach and left *in situ*, the free end being fixed by adhesive plaster to the forehead. Through this, half-pint feeds containing milk, glucose, and an adequate supply of vitamins should be given at two-hourly intervals. The delirious patient does not usually tolerate the tube, but can generally be persuaded by an efficient nurse to take enough nourishment in fluid form. It is important to keep a record of the daily intake.

Treatment in confusional stage

In the confusional stage the patient is less in need of skilled nursing but must be under continuous observation. Hypnotics may still be required, but it is wise to discontinue these as soon as possible, since they are apt to cause cumulative intoxication. Control and care are still needed, until the patient has recovered insight and memory sufficiently to be trusted to behave normally.

Lumbar puncture

If the patient is first seen in the phase of traumatic stupor, lumbar puncture should be performed and the pressure of the cerebrospinal fluid measured (see Vol. III, p. 57). A pressure higher than 200 mm. or a heavily blood-stained fluid indicates the need for repeated punctures at daily intervals until the pressure falls to a normal level (150 mm.) or the fluid is but faintly stained with blood. In the stage of delirium lumbar puncture may be managed in a quiet moment or when the patient is under the influence of drugs but is often impracticable. Increased intracranial pressure and subarachnoid haemorrhage are probably not very important in the causation of symptoms.

Treatment in mental hospital

Treatment in a mental hospital is sometimes necessary, for instance if the illness is protracted and adequate nursing cannot be obtained at home. In England and Wales the temporary certificate provided for by the Act of 1930 is usually applicable (see Vol. VIII, p. 565).

Convalescence

In the convalescent stage a graduated return to active life is advisable, and alcohol should be strictly avoided. Potassium bromide 10 grains or phenobarbitone (luminal) 1 grain should be given at bedtime for a year after the injury to reduce the risk of traumatic epilepsy.

3.–PSYCHOSES CAUSED BY FOCAL LESIONS

The distinction between this group and acute traumatic psychosis is to some extent uncertain. Many of the symptoms observed in the latter, e.g. defects of perception, perseveration, and disorders of speech, may possibly be due to scattered focal lesions. In so far as such symptoms are associated with, and tend to clear up with, the general confusion, it is convenient to regard them as a part of the acute traumatic psychosis. In some cases, however, the mental disorder depends mainly or entirely on a localized disturbance of function.

Morbid anatomy

Injury to brain

The morbid anatomy is a matter of surmise, save in penetrating wounds when destruction of brain substance can be assumed. The War 1914–18 provided many such examples. In the injuries of civil life the brain is not open for inspection, but when clinical signs of a focal lesion are apparent it is assumed that there has been massive haemorrhage or contusion in the appropriate area.

Clinical picture

In the early stages the clinical picture is usually that of an acute traumatic psychosis. As the clouding of consciousness passes off, the focal symptomatology is revealed. The symptoms which most commonly result in severe mental disorder are aphasia (especially of the sensory type), visual agnosia, and apraxia. In relation to any of these defects the patient is in a state of confusion which is mainly limited to the sphere of the defect but interferes with the mental function as a whole.

Symptoms of injury to frontal lobes

It is doubtful if any characteristic clinical picture results from injury to the frontal lobes. Pfeiffer, from his experience of war injuries, concluded that absence of initiative and spontaneous movement, amounting in its most severe degree to a state of catatonia, was symptomatic of frontal lobe contusions. According to Mapother, Korsakow's syndrome and demoralization are symptomatic of focal rather than of diffuse injury.

Korsakow's syndrome

Course and prognosis

Mental disorder due to focal injury tends towards improvement, at first rapid and later continuing slowly for as long as two years. In the early stages it is impossible to forecast the ultimate issue, but in most cases recovery, if not complete, is adequate for all ordinary purposes. Whether or not a slight residual defect will be disabling depends on the nature of the defect in relation to the patient's work. The slightest degree of aphasia, for instance, might disable a business man but not a labourer.

Treatment

Surgery

No special treatment is called for in these cases, beyond what has been described for the acute traumatic psychosis (see p. 358), except in so far as symptoms indicating a severe focal lesion may suggest the possibility of surgical relief. It is possible that in some cases of closed injury the cause may be a single large intracerebral haemorrhage capable of removal through a small cortical incision. If therefore symptoms of a focal lesion are recognized within the first fortnight and are severe, the question of an exploratory operation must be considered.

4.–PSYCHOSES ASSOCIATED WITH TRAUMATIC EPILEPSY

Traumatic epilepsy resulting from cortical damage may develop from a few weeks to several years after the injury, the maximal incidence being about a year after the trauma. The character of the attacks varies with the situation of the lesion. They are in most cases of the generalized rather than of the focal type and are often in the early stages of the minor degree (*petit mal*). The symptoms differ in no way from those of epilepsy from other causes, and the course, prognosis, and treatment are the same (see EPILEPSY, Vol. V, p. 108). Dementia is perhaps more frequently observed in traumatic than in idiopathic epilepsy. The clinical picture is the same. Excision of the cortical scar, if it can be localized, has been advocated and practised by Foerster and Penfield, but with inconclusive results.

5.–PSYCHOSES RESULTING FROM CHRONIC SUBDURAL HAEMATOMA

Morbid anatomy

The mode of origin of a subdural haematoma after head injury is imperfectly understood. It may be derived from the rupture of a vessel in the subdural space or from haemorrhage within the dura mater splitting the layers of this membrane. The effusion becomes encysted and tends to increase slowly in size as the result, it is supposed, of absorption of cerebrospinal fluid. The result is a cyst between the dural and arachnoid membranes containing a mixture of blood and tissue fluid. (See also Vol. III, p. 358.)

Clinical picture

Mental symptoms

The symptoms may develop several weeks or months after a head injury, which need not have been severe, and from which the patient may apparently have completely recovered. Headache is the commonest general symptom. The mental disorder, which in some cases is a conspicuous feature, takes the form of a progressive dementia, often presenting considerable fluctuations. The patient in the early stages may appear irritable, forgetful, and excitable; later there may be confusion and impulsive violence. Still later drowsiness supervenes, leading progressively but with fluctuations to stupor, coma, and death.

Course and prognosis

The rate of development of the symptoms varies, but the course of the illness may last several months. Possibly in some cases spontaneous cure is effected by absorption of the haematoma. Usually, however, the condition is fatal, unless it is correctly diagnosed and treated.

Diagnosis

When a patient known to have had a head injury within the preceding few months develops symptoms of progressive but fluctuating dementia associated with headache, chronic subdural haematoma should always be suspected, and in the presence of symptoms of increased intracranial pressure or a hemiparesis this diagnosis becomes probable.

In many cases of chronic subdural haematoma no story of head injury is forthcoming. The accident may have been trivial, and the disease itself be responsible for a defective memory. The condition has thus occasionally been diagnosed at autopsy in patients admitted to mental institutions.

Differential diagnosis

The differential diagnosis is from cerebral tumour, arteriosclerosis, syphilis, and senile dementia. The coincidence of recent head injury with any of these diseases is not very rare.

Treatment

Exploratory operation

If chronic subdural haematoma is seriously suspected in a case of mental disorder, an exploratory operation should be performed. The simplest and best method is to make four burr holes in the skull, one on either side of the middle line in the frontal and posterior parietal regions, through which the dura is exposed and incised. The subdural space can then be further explored in various directions with a soft rubber catheter. The contents of the cyst, if found, can be evacuated by aspiration.

6.–PSYCHOSES OF AFFECTIVE OR SCHIZOPHRENIC TYPE CONSEQUENT UPON ORGANIC CEREBRAL DAMAGE

In a patient emerging from an acute traumatic psychosis function at the highest levels of integration is still in abeyance, and, in consequence, concealed traits in the personality and underlying trends of mood may be revealed (see p. 357). It is therefore not surprising that at this stage symptoms of an affective or schizophrenic type sometimes develop in persons with a liability to these kinds of illness. In such cases allowance must be made for the consciousness of disability and feeling of injury bringing into play psychogenic as well as physical factors in the causation of the psychosis.

Head injury as direct cause of psychoses

In some cases, however, the mental disorder may develop after head injury in a manner which strongly suggests that the organic cerebral injury has been the determining factor, the patient emerging from unconsciousness into a state of affective or schizophrenic psychosis without any interval of awareness which would allow the possibility of psychogenic trauma. In a total of 229 cases of head injury associated with mental disorder definitely attributable to the injury Mapother found thirteen cases of affective psychosis without any interval of

Affective psychoses

recovery from the immediate effects of the injury. In all there was definite evidence of a disposition to this kind of illness before the injury. In the same series thirty-three cases of schizophrenic or paranoid psychosis occurred without interval after the injury, in twenty-four of which there was no definite evidence of a schizophrenic or paranoid disposition before the injury. Mapother concluded that schizoid states occurred sufficiently frequently after severe head injury to warrant the assumption that they might represent a stage in the recovery from generalized cerebral trauma.

Schizophreni or paranoid psychoses

Schilder, on the other hand, suggested that schizoid symptoms occurring in the course of an acute traumatic psychosis might represent the results of focal lesions, e.g. in the frontal lobes, and was unconvinced of the existence of traumatic schizophrenia. Some of his cases, however, are difficult to interpret upon any other basis.

The evidence at present available indicates that an affective or schizophrenic psychosis can be directly caused in a person with an appropriate predisposition by organic cerebral injury without the intervention of psychogenic factors, and that a schizophrenic psychosis may be so caused in a person with no such predisposition.

Treatment

The course, prognosis, and treatment of the illness, whether affective or schizophrenic, are the same as in that of non-traumatic origin (see pp. 267 and 302).

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PSYCHOTHERAPY

See PSYCHONEUROSES AND PSYCHOTHERAPY, p. 249

PTERYGIUM

See CONJUNCTIVA, INJURIES AND DISEASES, Vol. III, p. 374

PTOMAINE POISONING

See FOOD POISONING, Vol. V, p. 402

PTOSIS

See CRANIAL NERVE AFFECTIONS, Vol. III, p. 475

PUERPERIUM

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Sections on Bacteriology and Prevention of Puerperal Sepsis

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Reference may also be made to the following titles:

ANTENATAL CARE
FALLOPIAN TUBES DISEASES
LABOUR
MATERNAL MORTALITY
PLACENTA: DEVELOPMENT AND DISEASES
PREGNANCY, NORMAL AND PATHOLOGICAL
SHOCK AND COLLAPSE
UTERUS, DISEASES AND DISORDERS

1.–DEFINITION

1326.] The puerperium, the period of recovery after child-bearing, is characterized by three phases: (i) reaction for the first forty-eight hours; (ii) repair during the following ten days; and (iii) involution for an indefinite period afterwards.

Duration

The puerperium has hitherto been regarded as contemporaneous with the lying-in period, but the latter varies so much in different parts of the world and even in different parts of the same country that the term has little meaning and no scientific value. Moreover, it is clearly a mistake to suppose that the ten or fourteen days commonly assigned to the lying-in period in civilized countries are sufficient for complete restoration of the non-pregnant state. Under optimal conditions ten days may be enough for the readjustment of the physiological changes induced by the reproductive process, but such a short interval of rest does not permit complete involution; much less can it suffice to repair injuries occurring at birth. It has long been known that unhealed injuries and incomplete involution are responsible for much permanent disability, which might be avoided if greater care were given to the patient during the post-natal period.

2.–PHYSIOLOGY OF THE PUERPERIUM

(1)—Involution

(*a*) *Definition*

Involution is the process by which the organs of the parturient woman are restored to their normal non-pregnant state. The degree to which this restoration is carried out varies even in healthy women, but it is never perfect, since many of the bodily changes induced by conception cannot be effaced and the stigmata of child-bearing are discernible in every parous woman. The term 'normal involution' therefore indicates a standard of recovery which is not amenable to exact measurement but which implies a satisfactory physiological response on the part of the maternal organs.

Sub- and super-involution

The term subinvolution indicates that the reaction of the tissues has been deficient, and superinvolution (a much rarer event) that it has been excessive: in both conditions there may be serious disturbance of structure and function.

(*b*) *Physiology of Involution*

Involution may fitly be described as a process of vital demolition and reconstruction during which unwanted tissues are removed, breaches in the walls of the birth canal are repaired, the reproductive cycle is completed, and menstrual rhythm is restored; throughout this more or less destructive period birth injuries are healed, and an entirely new function, lactation, is set up and maintained.

In order to understand these remarkable changes some reference must be made to the preceding phenomena. The growth and structural changes which take place during pregnancy are initiated by the ovarian hormones acting under the influence of the anterior pituitary and controlled later by the placenta and other endocrine glands. The

Regular menstrual changes

earliest changes, the scaffolding so to speak, are set up by the hormone progesterone during the secretory phase of every normal menstrual period and demolished, if the ovum is not fertilized, by the action of the posterior pituitary and other pressor bodies during menstruation. These processes of building-up and breaking-down, which occur in the short space of a menstrual cycle, show in miniature what happens on a larger scale during the reproductive cycle and thus throw much light upon uterine activity during labour and the puerperium.

Changes following fertilization of ovum

After the successful fertilization of the ovum the corpus luteum enlarges, the endometrium is converted into the decidua of pregnancy, and all those changes follow which are necessary for the well-being of the living and growing ovum. For the continual growth of the uterus and other maternal organs two things are necessary: the presence of a living ovum and the maintenance of an endocrine balance in which progesterone and its allies are dominant. If this endocrine balance is disturbed in favour of oestrin and the posterior pituitary hormone, labour comes on, the foetus is expelled, and involution takes place.

Sequels to death of ovum

When the ovum or foetus dies *in utero*, labour generally ensues and involution begins. On the other hand, a dead ovum may sometimes be retained *in utero* for a relatively long period, during which active growth of the uterus and maternal organs ceases, but involutionary changes do not set in. Although death of the ovum inhibits growth it does not in itself initiate involution; involution depends essentially on those hormonal factors which stimulate and control the evacuation of the foetus (living or dead), i.e. the process of delivery. Labour is, in fact, the violent initial stage of an otherwise gentle process of demolition and an essential phase of involution. Much clinical evidence might be adduced in support of this view.

It has long been known that delayed labour might be followed by imperfect involution, but it is now realized that uterine inertia and subinvolution are both expressions of the same pathological state in which there is endocrinal dysfunction. In cases of intra-uterine retention of a dead foetus labour and involution remain in abeyance because there is a deficiency of oestrin and the posterior-pituitary hormone, administration of which may stimulate uterine activity (Datnow and Jeffcoate).

Effect of lactation on involution

The general influence of lactation upon involution has long been recognized, but the *modus operandi* is not yet fully understood. Suckling stimulates uterine contractions and promotes involution, and mammary activity inhibits ovulation and menstruation. This anomalous situation, in which one and the same factor (admittedly through different hormonal agents) stimulates the restoration of structure but inhibits the return of function, illustrates the delicate and complicated nature of the endocrine mechanism which regulates the whole process of involution.

(*c*) *Structural Changes*

Few parts of the body escape structural alteration during pregnancy, but the birth canal is chiefly affected. Many of the changes in distant organs are due to simple tissue reactions and are readily disposed of subsequently (oedema, pigmentation, mobilization of reserve function). Some of the uterine changes also fall into this category; the regeneration of the endometrium from the epithelial remnants of the decidual glands, and the reduction of the musculature by fatty degeneration and autolysis of its component fibres are comparatively simple procedures, but the reconstruction of the vascular field and the removal of unwanted vessels present a more difficult problem. The vessels no longer necessary are disposed of by a complicated process which reduces the calibre of the lumen and leads to an additional amount of elastic tissue in the outer coat; this increase of elastic tissue is found in the vessels of every parous uterus, and progresses with each succeeding labour until a great excess may be found in the old multipara; formerly an excessive quantity was considered to indicate subinvolution. The general diminution in size is not due to mere atrophy but is carried through by a vital reaction which increases muscle tone and thus restores the elongated and softened supports of the birth canal to their normal size and strength.

Endothelium and muscles of uterus

Blood-vessels

(*d*) *Repair of Injury*

The healing of birth injuries takes place while involution is in progress, but the two processes are to some extent antagonistic. The destruction of unwanted muscle does not encourage the formation of a sound scar in the uterine wall, and, similarly, the tissue reactions associated with the healing of a clean wound do not assist in the disposal of unwanted tissue. This mutual antagonism explains why lacerations of the birth canal, especially infected wounds, are such a constant cause of subinvolution.

(*e*) *Restoration of Function*

Sexual functions

The sexual functions return when the placental site and the lower reaches of the birth canal are completely healed. The supporting functions of the birth canal are not restored so quickly, and the pelvic floor and uterine ligaments do not regain their normal size and tonicity for many months after delivery.

Supporting functions

Reproductive function

The return of reproductive function is delayed still further in most women, because menstruation and ovulation do not begin until lactation has terminated, although ovarian activity may occasionally recommence while the child is still at the breast.

(*f*) *Clinical Signs of Healthy Involution*

Size and position

The uterus should be normal in size. After the first twenty-four hours, during which relaxation occurs and the uterus may rise in the abdomen, the fundus should descend daily and disappear below the symphysis pubis on about the tenth day after delivery. The whole organ should then feel firm and be practically painless. It should be anteflexed, the os should be closed, and the uterine cavity should measure not more than three inches by sound.

Lochia

The lochia should be normal, i.e. should consist of blood, serum, and mucus; they should not contain abnormal elements, such as placental debris, pus, and necrotic tissue. The loss should not be excessive, nor should the odour be offensive. The discharge should become colourless on about the seventh day and finally give place to the ordinary white leucorrhoeal discharge before the lying-in period is over.

At the end of the puerperium examination should not reveal any gross physical signs in the pelvis, nor should the patient complain of any unpleasant subjective sensations.

(2)—Subinvolution

(*a*) *Aetiology and Clinical Picture*

Causes

There are two main causes of subinvolution: (i) the necessary hormonal stimulus may be lacking owing to general ill-health or to some defect in the ductless glands; and (ii) the maternal organs may be incapable of responding to normal hormonal stimuli owing to local disease or injury.

Clinical signs

Immediate

Remote

Signs of subinvolution may be immediate or remote. The immediate signs are: (i) persistent red lochia, (ii) undue enlargement of the uterus, (iii) retroversion and incipient prolapse, (iv) unhealed wounds, (v) backache, and (vi) pelvic discomfort. The remote signs include: (i) persistent uterine displacement, (ii) menstrual irregularity and menorrhagia, and (iii) sterility, temporary or permanent.

(*b*) *Treatment*

Subinvolution may be more easily prevented than cured, and the prognosis depends largely on the time at which the patient comes under observation.

Preventive

Good antenatal work and skilful midwifery, which prevent the occurrence of injury, shock, and infection, will eliminate many of those factors which tend to interfere with the process of involution.

Specific

Symptomatic

Oestrogenic hormones, oxytocic agents and pressor substances such as preparations of posterior pituitary, oestrin and progestin (progesterone), ergot, and calcium have a specific effect upon involution and should be given as a routine whenever this process is delayed, especially to patients with clinical evidence of endocrine defect, such as obesity, history of delayed labour, uterine inertia, and lack of muscle tone. Any symptoms or signs of general ill-health, such as anaemia, debility, and tuberculosis, must be investigated and treated.

Treatment of injuries

Of infections

All injuries tend to inhibit the process of involution. Additional rest must therefore be allowed after repair operations, and every care must be taken to secure primary union of such wounds. All forms of infection delay recovery of muscle tone, especially endometritis and sapraemia, which cause necrosis of the uterine wall. An empty uterus and good drainage are the best safeguards against such risk, and hot douches, glycerin tampons, and astringent applications may be used as palliative measures.

Treatment of displacements of uterus

Retroversion and subinvolution are very closely related. A heavy subinvoluted uterus tends to fall backwards, and an acquired retroversion impedes drainage and renders further involution more difficult. Posture, manual replacement, and a Hodge pessary will overcome this difficulty.

Prolapse

Prolapse is more often the result of faulty involution than the cause of it; in cases of procidentia complicating pregnancy special precautions should be taken against the occurrence of prolapse after delivery, for, if descent occurs, subinvolution will certainly follow.

Inversion

The subacute type of inversion of the uterus and vagina is very rare, but it leads to a severe and often permanent degree of subinvolution.

(3)—Superinvolution

Definition

Superinvolution is a condition in which involution proceeds too far and induces atrophy of the uterus and ovaries; in most instances this atrophy is not discovered until many weeks or months after delivery. It was formerly considered to be the result of prolonged lactation and spoken of as 'lactation atrophy'. Superinvolution is not primarily a disease of the puerperium; it is, however, probably initiated during that period.

'Lactation atrophy'

Aetiology

The available clinical and pathological data show that superinvolution is a manifestation of endocrine defect, but the exact causation has not yet been determined. Prolonged lactation with depletion of calcium is one of the responsible factors, and no doubt the anterior pituitary and parathyroids, the latter of which are closely concerned with calcium metabolism, are also implicated. As a result of this disturbance ovarian function is inhibited or in the worst cases destroyed, and a disuse atrophy of the uterus follows, comparable with that which occurs at the menopause.

Clinical signs

There are two main clinical types: (i) mild, characterized by a uterus smaller than normal and an impaired menstrual function but few other bodily changes, the outlook being good; and (ii) severe, in which the uterus becomes completely atrophic, menstruation is entirely suppressed, sterility is permanent, and the bodily changes of a premature menopause follow. Here the diagnosis is obvious, but the outlook for the return of function and structure is almost hopeless.

Diagnosis

Excessive involution is generally suggested by the persistence of amenorrhoea after lactation has ceased or by the appearance of menopausal changes. It is necessary first to exclude pathological causes of amenorrhoea, such as tuberculosis, and to remember that pregnancy may supervene upon lactation, and then to confirm the diagnosis by a careful examination of the pelvic organs and measurement of the uterus.

General treatment

Debility, anaemia, and calcium depletion must be treated appropriately. Lactation must be stopped and the general health of the patient investigated. In some women simple measures are followed by a return of normal menstrual function.

In resistant cases, however, or when there is clear evidence of endocrine

Hormone treatment

Thyroid

defect, hormone treatment should be started without delay. Thyroid should be given in increasing amounts depending on the toleration of the patient.

Anterior pituitary

Failing any response to thyroid therapy, anterior pituitary gonadotropic hormones should be injected, in the hope that they will stimulate the ovary and restore its capacity to produce oestrogenic hormones. As an adjuvant or alternative to gonadotropic therapy, oestrin and progestin may be employed. These hormones act directly upon the uterus and not only stimulate growth but regulate function. Oral administration is not advisable because a large fraction, if not the whole, of the hormone is destroyed during digestion and absorption. The application of haphazard and rule of thumb methods to hormone therapy cannot be too strongly deprecated. Treatment must be based upon physiological principles and the therapist must not only supply the tissues with an adequate amount of active hormones but must introduce them in proper sequence if he is to set up that cycle of hormone activity which alone can provoke and maintain the normal menstrual rhythm. Each hormone must be administered during that part of the cycle when it is normally dominant: i.e. oestrin must be given immediately after menstruation during the two or three weeks in which the Graafian follicle is active, and progestin prior to menstruation during the week or ten days in which the corpus luteum assumes control (Kaufmann). Attention to detail in regard to dosage and mode and time of administration is imperative and the reader is urged to study these details in one of the special articles or monographs which deal with this subject. Many patients may with advantage be referred to special hormone clinics which are now attached to many gynaecological hospitals.

Ovarian hormones

3.–MANAGEMENT OF THE NORMAL PUERPERIUM

(1)—After-Pains

1327.] Many puerperal patients suffer from colicky pains in the hypogastrium due to ineffective and irregular contractions of the musculature of the birth canal. Their occurrence implies the presence of an atonic uterus which is unable to expel its contents immediately and thus permits the accumulation of clots within its cavity. The subsequent expression of, or attempt to express, these clots is the chief source of the pain.

Treatment

Uterine spasm may be inhibited or allayed by sedatives, such as morphine and bromide; but although narcotics provide immediate relief from the pain they do not touch its source. Correct treatment consists in trying to improve the uterine tone by stimulating efficient uterine contractions; this may be effected by the administration of various oxytocic agents, such as 0·5 c.c. of posterior pituitary extract four-hourly for two or three days and quinine and ergot by the mouth; injection of progestin has also been advocated for this purpose. These substances accelerate uterine drainage, prevent the retention of clots, and promote the processes of involution.

Diagnosis from other pains

Care must be taken to avoid confusing after-pains with other kinds of abdominal pain following delivery. They can easily be recognized by: (i) localization of the tenderness to the area of the uterus, (ii) the association of the pains with changes in consistence of the uterine muscle, and (iii) their intermittent or rhythmic character.

(2)—Care of the Bladder

Causes of difficulty

After normal labour some difficulty of micturition is not unusual, especially in primiparae, in whom bruising or contusion of the tissues surrounding the bladder and urethra is almost inevitable: such injuries produce spasm of the sphincter, which makes voluntary efforts painful. Changes in the relative positions of the viscera are also contributory factors. Generally the midwife is able to overcome the difficulty by simple measures, but, should these efforts fail, resort must be made to the catheter. Whenever catheterization is necessary, it is advisable before withdrawing the instrument to run into the bladder an ounce of some antiseptic, such as potassium permanganate solution, 1 in 5,000.

Treatment

(3)—Bowels

Unless there is some contra-indication to the early administration of aperients, such as the repair of a damaged sphincter ani muscle (when it may be necessary to keep the bowels closed for five to six days), steps should be taken to open the bowels on the second or third day. The choice of aperient is of little moment, but the use of saline purgatives should be deprecated during lactation, and it is generally wise to prescribe an aperient which has previously gained the confidence of the patient. It may be necessary to assist the bowels in this way throughout the lying-in period and for many weeks afterwards, since the lack of exercise, the milk diet, and the slackened pelvic floor all tend to produce constipation. Constipation encourages prolapse in so far as a loaded rectum interferes with the processes of involution, and straining at stool imposes a heavy strain upon the muscles of the pelvic floor.

Aperients

(4)—Diet

Diet during the puerperium does not present any special problems in a healthy woman. It should consist of simple wholesome food containing the necessary caloric value, and special measures should be adopted to counteract the strain of lactation and to avoid the ingestion of foods which may affect the quality of the milk. Extra fluid is a necessity, and cows' and goats' milk are particularly useful in supplying this need, for they contain a relatively large quantity of vitamins and calcium (Garry and Stiven).

(5)—Nursing

It is essential that everywhere efforts should be made to improve the standard of maternity nursing and to provide the services of an efficient midwife. In this respect the conditions and training methods obtaining in Holland and Denmark are well worth careful consideration.

(6)—Pulse

The clinical characters, rhythm, and rapidity of the pulse must be noted and recorded at regular intervals, for they are an important indication of the condition and progress of the patient. Bradycardia, not uncommon during the first week of the lying-in period, has little significance; a persistent or progressive increase in the pulse-rate should always arouse suspicion and other evidence of shock, haemorrhage, and infection should be searched for.

(7)—Posture

After the fatigue of labour has passed away in the restful sleep that follows normal child-birth, the recumbent posture may with advantage be exchanged for the Fowler position, but, during the ensuing days, frequent changes of posture should be encouraged in healthy women. This practice has several advantages: (i) the Fowler position promotes drainage and prevents the retention of lochia; (ii) changes of posture invoke muscular movements which stimulate the circulation and reduce the risk of thrombosis and embolism; (iii) the adoption of the prone position for a few minutes each day helps to prevent backward displacement of the uterus; and (iv) special postures may be required to facilitate lactation, micturition, and defaecation, and their assumption for short periods cannot harm a healthy woman.

Upright posture

The exact date on which the puerperal woman can safely rise from bed depends on many factors, but chiefly upon her general progress and the state of involution of the genital organs. If the patient gets out of bed during the reactionary period, there is undoubted risk of collapse and infection, but it is unnecessary to keep well-recovered patients in bed too long. As a rule a healthy woman should be allowed to get up when a careful examination has shown that the resumption of the upright posture and moderate muscular effort will not adversely affect her continued progress towards complete recovery; but, although such patients may be allowed to enjoy a reasonable amount of freedom when that stage is reached, it should be explained to them that the lying-in period is merely the first part of their convalescence, and that perfect involution and repair cannot be accomplished unless the second or ambulant stage of the postnatal period is treated with respect. During this period patients should be warned against all forms of fatigue and over-exertion, and permission to play strenuous games should be withheld until lactation has ceased and menstruation has recommenced.

(8)—Temperature

Any gross departure from the normal temperature should be investigated immediately. Shock, haemorrhage, and other complications produce fairly characteristic changes in the temperature chart. The main difficulty in interpretation concerns sudden rises of temperature soon after delivery, when it may be difficult to differentiate between reactionary states due to nervous or toxic factors and the onset of acute infection. The significance of the various forms of fever is discussed on page 395.

(9)—Visitors

Visitors should be restricted to the husband and the immediate relatives during the first week of the puerperium. The dangers arising from healthy carriers of infection must not be forgotten, and all sick persons, including the members of the patient's family, must be rigidly excluded from the lying-in room. This rule is absolute and must never be relaxed, whatever the importunities of the patient or her friends.

(10)—Vulval Toilet

Changes in vaginal secretions

The protection afforded by the normal acidity of the vaginal secretions is temporarily lost during the puerperium, because the lochia are alkaline and consist chiefly of blood (see LEUCORRHOEA, Vol. VII, p. 712). For this and other reasons the birth canal is extremely vulnerable during the early days following delivery, and it is essential that the vulval toilet should prevent the entrance of organisms until the placental site is healed and the normal protective mechanism has been re-established.

Vulval pads

The vulval pads should be made of absorbent wool and impregnated with an efficient antiseptic. They should be changed whenever they become saturated and after defaecation and micturition. The risks arising from droplet infection admittedly reach their maximum in hospital practice, in which many patients are nursed in close contact with each other; but they are never absent from domiciliary work, and care must always be taken to eliminate this source of danger during the dressing of the vulva. Under ideal conditions the midwife should wear rubber gloves, cap and mask, and sterile gown, and should regard the vulvo-vaginal junction as the lower end of an open defenceless wound and carry out each dressing with scrupulous attention to detail.

(11)—Post-natal Examination

A complete examination of the patient must be carried out at the end of the second week of the puerperium and should take the form of a clinical stocktaking during which the results of labour are assessed, the present condition is determined, and the future prospects are reviewed.

The results may be divided into four categories.

Categories of patients

(i) General health good; involution, lactation, and uro-genital function satisfactory. This is the perfect physiological response. The puerperium is complete, and the patient is ready for the 'ambulant' stage of recovery.

(ii) General health good; involution, lactation, and uro-genital functions deficient but not disordered. This is an imperfect physiological response; the puerperium is still incomplete, and further rest and nursing are required.

(iii) General health impaired by child-bearing; involution, lactation, and uro-genital functions disordered as well as deficient. Here the response is pathological; the puerperium is morbid as well as incomplete, and special steps must be taken to prevent permanent disability.

(iv) General health impaired by the presence of organic disease not due to child-bearing, although possibly aggravated by it. This important group is composed of women to whom the ordinary standards of puerperal recovery cannot be applied and for whom the most careful consideration and special treatment may be necessary. For many such women further child-bearing involves a grave and unjustifiable risk, and for them excision of the tubes or some comparable procedure should be regarded as an essential part of the post-natal treatment.

A favourable report does not mean the final dismissal of the patient but rather her transfer to the ambulant phase of the post-natal period; an unfavourable result indicates that further rest and perhaps prolonged medical attention are required. The general adoption of better post-natal methods and the provision of special treatment would lead to a material reduction in the amount of maternal disability which is at present associated with child-bearing in almost every part of the world.

4.–COMPLICATIONS OTHER THAN SEPSIS

(1)—Bladder Complications

(*a*) *Cystitis*

1328.] Although grave injuries of the bladder are rare, contusion and bruising are usual complications of labour, and retention of urine is a common sequel. These factors lower the resistance of the vesical tissues and render them vulnerable to the attack of organisms already present in the bladder, and the shortness of the female urethra readily permits invasion from without.

Puerperal cystitis resembles other forms of bladder infection, and the clinical signs and treatment are identical, but, in view of the risk of extension to other parts of the genito-urinary field, the prognosis should be more guarded (see BLADDER DISEASES, Vol. II, p. 396).

(*b*) *Fistulae*

Various types of fistulae may be established between the bladder and other hollow viscera. The vesico-vaginal form is much the commonest.

Vesico-vaginal fistula

It may arise in one of two ways: (i) as an immediate result of operative injury, generally the unskilful use of forceps; and (ii) as a secondary result of obstructed labour during which the soft parts of the mother are subjected to prolonged pressure between the foetal head and the symphysis pubis. This leads to pressure necrosis, the separation of sloughs, and the formation of a fistula which occurs between the seventh and tenth days. The diagnosis is suggested by the onset of complete incontinence and confirmed by use of the vaginal speculum and injection of coloured fluid into the bladder. An attempt may be made to promote healing during the puerperium by: (i) the introduction of a self-retaining catheter; (ii) special posture so arranged as to prevent urine trickling through the fistulous opening; and (iii) local application of antiseptics to the affected area and the use of urinary antiseptics; this is always advisable. *Treatment*

It is exceptional for such an injury to heal spontaneously, and in most cases resort must be made to operation. It is unwise to make any formal attempt at repair until the local infection has cleared up and the vaginal and vesical tissues are in a healthy condition, a state of affairs which can hardly be obtained in less than three to six months. *Surgery*

(*c*) *Overflow Incontinence*

This is the end-result of neglected or overlooked retention. Retention leads to a full bladder, then to distension, and finally to over-distension with partial paralysis of the muscular walls. This loss of muscle tone relaxes the sphincter mechanism and allows small quantities of urine to escape from the bladder, but, since the contractile power of the vesical muscles has been lost, the bladder cannot empty itself and the passage of urine merely indicates that the full bladder is overflowing. This condition predisposes to bladder infection and if treatment is much delayed a serious and perhaps permanent disability may ensue. *Cause*

Treatment consists in drainage by means of a self-retaining catheter until the bladder wall has regained its muscle tone; urinary antiseptics; and posterior pituitary extract. *Treatment*

(*d*) *Retention of Urine*

Urinary retention is favoured by the following conditions which normally obtain after delivery: spasm of the sphincter of the urethra due to contusion and bruising, the recumbent posture of the patient, and the fall in abdominal pressure due to evacuation of the uterus. Moreover, the needs of the bladder may be overlooked during a long and difficult labour in which narcotics and anaesthetics are employed, so that retention may have set in long before delivery. Vesical sensations are also apt to be less insistent during the early part of the puerperium, when the patient may attribute her abdominal discomfort to some other cause and regard overflow incontinence and other bladder troubles as usual events.

Treatment consists in proper attention to the bladder during labour, especially before operative delivery, simple nursing manœuvres such as posture, and the passage of a catheter. *Treatment*

The catheter should be passed at regular intervals until the patient has regained the power of voluntary micturition. The intervals should not exceed eight hours, otherwise the patient may suffer from recurrent distension rather than retention; this not only increases the risk of *Catheterization* infection but also postpones the return of voluntary control. The intervals between catheterizations should be shortened whenever there is any suspicion of cystitis, or a self-retaining catheter used instead of the ordinary type.

(*e*) *Stress Incontinence*

Definition

This means that control of the bladder is lost on exertion but retained more or less normally when the patient is at rest. Any movement, voluntary or involuntary, that exerts pressure upon the pelvic floor will cause escape of urine in affected women, although the degree of the disability varies greatly in its severity. This disability does not become fully developed until weeks or even months after delivery, but it is due to birth trauma, and the loss of control begins during the puerperium.

Causation

There are several causes: (i) over-stretching of the anterior half of the pelvic floor and its contents during the second stage of labour with injury to the pubovesical muscles and consequent dislocation of the urethra; (ii) subinvolution causing urethrocele and general laxity of the urethral musculature; and (iii) neglect of the bladder during the puerperium, especially when it leads to overflow incontinence.

Clinical picture

The symptoms are pathognomonic in most cases, but the condition may be simulated by purely functional disturbances of micturition associated with neurosis. The clinical examination will soon dispose of those difficulties and settle the diagnosis.

Physical signs

The characteristic physical signs are a mobile urethra which sags downwards on muscular exertion, general laxity of the tissues round the urethral orifice, and a thin-walled urethra of wide calibre. Cystocele is generally but not always associated, and in some of the most intractable cases the pathological changes are limited to the urethra.

Treatment

The incidence of this condition may be reduced by good antenatal work, skilful midwifery, and careful supervision of the puerperium. The incipient stages may be checked by the prophylactic use of a ring pessary, and the institution of vigorous methods for the relief of any associated subinvolution. When the condition is once established, a plastic operation upon the urethra and vagina offers the only hope of cure. When this is refused or operation has proved a failure, a large rigid vulcanite pessary of the Hodge type may afford considerable relief by exerting pressure on the dilated and prolapsed urethra.

(2)—Displacements of Uterus

Pathological displacements of the uterus more commonly arise in connexion with pregnancy (retroversion), the third stage of labour (inversion), and the late post-natal period (prolapse and retroversion) but nevertheless may develop during the puerperium and demand serious attention.

Inversion

Inversion most often occurs during the third stage of labour and thus causes one of the rarer but most dangerous types of puerperal shock. It may, however, take place slowly and appear for the first time during the puerperium.

Treatment consists in control of haemorrhage and shock, antiseptic dressings, and replacement, either manually or by means of a repositor, after the shock has passed.

Retroversion

Backward displacement or retroversion may fairly be described as puerperal in origin in many cases, although it is not always pathological. In most cases it is due to a combination of factors: (i) the weight of the relatively heavy corpus uteri; (ii) the extremely soft lower uterine segment; and (iii) the dorsal posture, which, if persisted in, encourages the heavy corpus to drop backwards at its junction with the soft lower uterine segment.

When this condition is discovered in the post-natal period, a distinction must be drawn between a retroverted uterus which is small, mobile, and painless, and another which is bulky, tender, and more or less fixed. In the first type the position is probably congenital in origin and physiological in character and thus does not require treatment. In the second case the retroversion is almost certainly an acquired condition, is generally associated with subinvolution and therefore demands attention.

Treatment should include the promotion of good involution, manual replacement of the uterus, and the use of a Hodge pessary for three months.

Prolapse

Descent of the genital organs is generally the result of two chief factors which come into play during the puerperium, although their results may not be discovered until later: (i) laceration of the pelvic floor and birth canal, and (ii) subinvolution of the supporting structures.

Every effort must be made to eliminate these causes of descent or to reduce their pathological effect by repair of injuries, treatment of infected wounds, avoidance of strain and over-exertion until involution is satisfactory, and the use of a ring pessary during the stage of muscular weakness.

(3)—Embolism and Sudden Death

Sudden death during the puerperium is rare, but may arise from various causes, of which the following are the commonest: pulmonary embolism, air embolism, heart failure, obstetric shock, eclampsia, and post-partum haemorrhage. The possibility of a fatal issue must always be borne in mind when dealing with these conditions, but many of these fatalities are unavoidable.

(4)—Haemorrhage

Cause

Frank haemorrhage in the course of the puerperium is almost invariably due to the separation of a piece of retained placenta. The loss of blood may be very severe, and in such circumstances it is wise to explore the uterus under anaesthesia in order to remove manually any other portions of placenta that may still adhere to the uterine wall. Other rare causes are secondary haemorrhage from infected wounds, subacute inversion of the uterus, and bleeding polypoid tumours. In each case the treatment must be adapted to the causal condition.

(5)—Insanity

The onset of mental disturbance may be associated with the puerperium in various ways: (i) a lunatic may conceive and be delivered at term; (ii) a potential psychotic may become actively insane as a result of the strain of pregnancy or labour; and (iii) mental symptoms may be toxic in origin and form part of the clinical picture of eclampsia and puerperal fever.

A puerperal woman who is not responsible for her actions (and English Law considers that the pangs of labour may render any woman temporarily irresponsible) should be placed under proper control, in order that she may be prevented from harming herself, her offspring, or other people, and she should be kept under restraint until the mental disturbance has cleared up.

Prognosis

The prognosis depends chiefly on two factors: the past mental history and the cause of the mental disturbance. The outlook for patients with a bad family or personal history is never good, and the risk is increased by those abnormalities or complications of child-bearing which impose severe mental and physical stress, and by any general morbid condition, such as prolonged lactation and anaemia. On the other hand the prognosis in cases due to eclampsia, puerperal fever, or sudden mental stress is much better, and complete recovery may be expected so long as there is no mental taint in the family. See also PSYCHOSES, p. 326.

(6)—Pyelitis

Pyelitis is not peculiar to the puerperium, although it is specially prone to occur at this time, when it constitutes an important cause of puerperal pyrexia.

Diagnosis

The diagnosis should be based upon the discovery of acid urine containing pus cells and organisms, painful enlargement of the affected kidney, and tenderness on pressure over the costo-renal angle: frequency of micturition, dysuria, a high temperature, with rigors and a relatively slow pulse-rate are also characteristic features of the clinical picture. Disturbance of the pulse-temperature ratio is almost pathognomonic of pyelitis and is frequently a decisive point in the differential diagnosis.

Treatment

Treatment follows the usual lines (see PYELITIS, p. 411) but special care must be taken on account of the tendency of puerperal pyelitis to recur and become chronic. Treatment must therefore be vigorous and prolonged.

(7)—Shock

(*a*) *Primary Obstetric Shock*

The work of Cushing and others has shown that shock is due to repression of the vital centres of the brain and associated with dilatation of the capillaries and a marked fall in blood-pressure. The condition may arise suddenly or comparatively suddenly in response to violent stimulation of afferent nerves by pain or injury and give rise to the well known and easily recognizable features of primary surgical shock.

Injuries and accidents sustained during child-birth in general induce a degree of shock proportional to the severity of the injury and the appearance of shock in these circumstances is familiar to every obstetrician.

(b) *Secondary Obstetric Shock*

There is, however, an unexpected and highly dangerous form of obstetric shock that may arise apart from severe trauma. The cause of this condition is obscure; the onset is insidious, and the few premonitory symptoms may escape attention until the condition has advanced to a stage at which treatment is difficult and sometimes futile. For a complete description of this serious complication, the reader is referred to a paper by Miles Phillips.

Causation

Several apparently innocent factors are at work which exert an almost imperceptible but persistently harmful effect on the patient. They include fatigue, pain, anxiety, slight loss of blood, exposure to cold, anaesthesia, lack of nourishment, toxins, and minor and invisible lacerations. The influence of any one of these factors is insignificant but when acting together they become formidable. The pathological effect is almost negligible at first, but its action is persistent and its effects cumulative.

In addition to the above causes, two others are of special interest to the obstetrician: (i) the marked drop in intra-abdominal pressure, which follows expulsion of the foetus, may cause sudden dilatation of the large abdominal veins and in this way embarrass the circulation of the brain and deplete the capillary system; and (ii) some authorities believe that toxic bodies resembling histamine may appear in the circulation soon after delivery. These substances, by dilating the capillaries and increasing the permeability of their walls, deplete the circulation, lower the blood-pressure, and thus induce or increase shock. They are stated to develop in lacerated muscles and even in the normal placental site, and, if so, it is obvious that a potential source of future shock is present at every labour. Moreover, the interval which must necessarily elapse between the development of these toxins in the tissues and their absorption into the blood-stream affords a reasonable explanation of the latent period which is so characteristic of this dangerous state (secondary or delayed obstetric shock).

Clinical signs of stage of development of shock

During the latent period a progressive fall of blood-pressure is the earliest and may be the only sign. It is, however, usual for the patient to show other signs, such as pallor, increased pulse-rate, and bleeding, but often of such a mild degree as to escape notice unless the attendants are particularly observant or routine measurements of the blood-pressure are made. Failure to recognize the existence of this syndrome entails loss of valuable time and gravely affects the prognosis, whereas skilled treatment during the fateful prodromal period will generally avert the dangerous stage.

Stage of maturity

The clinical manifestations of established obstetric shock are identical with those of the primary surgical type. All the main bodily functions are depressed; the patient is pale, apathetic, and more or less unconscious. The pulse is small and rapid, the blood-pressure very low, the temperature subnormal, and the respirations shallow. The condition is generally recognizable at a glance.

Diagnosis

The main difficulty in differential diagnosis is the resemblance between the clinical signs of shock and those of haemorrhage. Progressive pallor, increase in the pulse-rate, and depression of the temperature and blood-pressure are common to both syndromes, but, whereas air hunger and mental acuity are typical of haemorrhage, shallow breathing and mental dullness or unconsciousness characterize shock.

(*c*) *Treatment*

Preventive methods: general

Treatment may be preventive and symptomatic, but no specific or strictly surgical measures are available. Both forms of shock may be prevented or at least mitigated by the elimination of those aetiological factors which have already been discussed, and especially by the prevention of birth injuries. For the successful prevention of secondary obstetric shock more rigorous control must be exercised upon the third stage of labour and the subsequent period of reaction.

Special

During labour much may be done to prevent the subsequent onset of shock by attention to the following details: prevention of nervous prostration and mental distress by the use of sedatives and analgesics; the limitation of physical suffering and bodily fatigue by the judicious adoption of appropriate means for expediting and assisting delivery; conservation of bodily heat and especially prevention of chill after delivery in exhausted patients and those under the influence of anaesthetics; provision of adequate nourishment throughout the process of parturition; scrupulous control of haemorrhage; substitution of local or spinal anaesthesia or gas and oxygen for chloroform and other anaesthetics which have a depressive action upon the blood-pressure; adoption of appropriate means for dealing with toxaemia and other complications of labour which predispose to shock; and avoidance of all unnecessary interference not only during labour but also immediately afterwards, and the postponement of non-essential operations whenever the general condition of the patient is unsatisfactory or there is reason to apprehend the onset of shock.

Immediate perineal repair during the stage of reaction submits the patient to further anaesthesia and manipulation, involves nerve injuries, and thus may materially encourage the onset of shock or intensify that condition if it has already arisen. Moreover, complete closure of perineal and pelvic wounds prevents drainage and encourages the absorption of toxic substances derived from the lacerated muscles. It is therefore necessary to estimate the blood-pressure whenever such operations are contemplated and not to proceed unless the reading is satisfactory.

Symptomatic treatment

In the absence or failure of preventive methods active treatment becomes necessary; it should be adapted to the particular circumstances of the case and based upon the symptoms and their underlying pathology.

The patient should be handled with extreme gentleness and as far as possible secure complete rest and quiet. Any obvious sources of shock, such as haemorrhage, must receive immediate attention. Bodily heat must be restored by warm drinks and protected hot water bottles. Mental distress and restlessness must be countered by sedatives. The blood-supply of the vital centres must be conserved by raising the foot of the bed, application of an abdominal binder, and, if necessary, by bandaging the limbs. The decreased blood volume, due to capillary dilatation and transudation of plasma, must be restored to normal by the transfusion of saline, gum solution, or whole blood. Such replacement must be made very slowly, or it will add an additional burden to the already labouring heart. Timely use of stimulants, such as camphor in oil and hot coffee, may tide the patient over a dangerous period of collapse, but such agents have little effect upon the profoundly depressed circulation and may be harmful in the presence of active bleeding.

5.–PUERPERAL SEPSIS

(1)—Definition

1329.] It is customary to restrict the term puerperal sepsis to conditions which arise during the lying-in period from the invasion of the birth canal by pathogenic organisms.

(2)—Aetiology

Incidence

Sepsis accounts for a large proportion of the total number of maternal deaths due to child-bearing, and, according to the records of those countries which publish statistics, the incidence of the disease has not appreciably declined since the time of Pasteur and Lister (see MATERNAL MORTALITY, Vol. VIII, p. 398). The present figures are misleading, for they are swollen by a number of deaths not directly attributable to child-bearing, such as pneumonia and influenza, and they also include a number due to illegal operations. The Director-General of Public Health in New South Wales reported that, whereas illegal operations were responsible in his own area for 3 per cent of the total mortality in 1910, they accounted for no less than 18·13 per cent in 1934. It is beyond question that these fatalities are chiefly due to sepsis and that a similar influence is at work throughout the world. Furthermore, with modern methods of notifying puerperal infections, many cases are included which formerly were attributable to other causes. But, when allowance has been made for all sources of statistical error and for cases due to illegal operations and unskilful midwifery, the fact remains that the gravity of puerperal sepsis remains unabated. Even in Holland, where the total maternal mortality has materially dropped in recent years, the amount of puerperal sepsis has relatively increased, and more disconcerting still is the fact that approximately one-half of the fatal cases follow normal labour. The explanation of this extraordinary fact has hitherto eluded the efforts of research workers.

Sepsis following illegal operations

Causation

Formerly the so-called idiopathic case was ascribed to an autogenous agency, coitus before labour, self-examination during delivery, or the dislodgment of dangerous organisms from the cervical glands during the first stage of labour. These factors may account for a few cases but do not afford a satisfactory explanation of the majority. Happily much of the obscurity surrounding this subject has been cleared up by the researches of Colebrook and his co-workers, who have shown that 'droplet' infection is the cause of the otherwise inexplicable case. Their views may be briefly summarized: puerperal infection is very rarely derived directly from organisms pre-existing in the patient's own tissues. Puerperal sepsis is a particular type of wound infection due to the invasion of the placental site and other breaches in the walls of the birth canal by extraneous organisms.

Droplet infection

(3)—Bacteriology

(*a*) *The Infecting Organisms*

The organisms which cause puerperal sepsis are few. In cases showing a slight transient rise of temperature a mixed growth of many organisms may be obtained from a cervical culture, but it is not possible to say how many of these are concerned in the fever. It is, however, the more serious cases with more persistent fever that cause anxiety in the puerperium, and in these cases the infecting organisms are usually members of a very small group and are often isolated from the cervix in pure or nearly pure culture.

The chief organisms concerned in puerperal sepsis are: the haemolytic streptococcus, the anaerobic streptococcus, *Bacterium coli*, the staphylococcus, *Cl. welchii*, and the pneumococcus.

Haemolytic streptococcus

The haemolytic streptococcus causes 60 to 65 per cent of severe and fatal cases and is by far the most important single cause of puerperal sepsis. Lancefield and Hare found that this high degree of pathogenicity is not shared equally by all the organisms generally described as haemolytic streptococci. They showed that the haemolytic streptococci can be divided by a precipitin reaction with suitable immune sera into nine groups. Of these groups one, known as group A, appears to be the only one which commonly causes severe human infections. A possible exception must be made for group B, since four fatal cases due to streptococci of this group have been observed at Queen Charlotte's Hospital; but such cases are excessively rare.

Anaerobic streptococci

The anaerobic streptococci form an ill defined group, probably consisting of a number of different organisms; they have the morphological characters of streptococci but will grow only under strictly anaerobic conditions. They are not haemolytic and grow poorly on all ordinary media. Although there are certainly several types of anaerobic streptococci, differing in their morphology and cultural characters (Colebrook and Hare), probably only a few of these are concerned in fatal infections, since the appearances at necropsies are remarkably constant in such cases. The anaerobic streptococci are responsible for about 20 per cent of severe and fatal cases.

Bact. coli

Bacterium coli and allied organisms are isolated occasionally from the genital tract in the puerperium. Many of these infections are mild, but a few severe or fatal infections are due to *Bact. coli*. Such cases nearly always show a heavy infection of the urinary tract, and, in fatal septicaemias, in addition to a severe uterine infection a haemic infection of the kidneys is common. *Bact. coli* infections of the bladder with no uterine involvement are a common cause of pyrexia in the puerperium.

Staphylococcus

Staphylococcus is found in cervical swabs, mixed with other organisms, in many cases with mild pyrexia. Much more rarely a staphylococcal infection becomes generalized, and with *Staph. aureus* in the bloodstream the outlook is very grave. *Staph. albus* is occasionally found in blood cultures from patients with moderately severe sepsis, but such cases generally do well.

Cl. welchii

Clostridium welchii infections in the puerperium are rare, but when they occur the mortality rate is high. Hill reported an exceptionally large series of 30 cases observed in Melbourne, infected by *Cl. welchii* and allied organisms, in which the mortality was 63 per cent.

Pneumococcus

Pneumococcus has been occasionally reported as the infecting organism, but these infections are so rare that none has been observed at Queen Charlotte's Isolation Block in six years, out of a total of 1,700 cases.

(*b*) *Source of the Infecting Organisms*

Organisms other than haemolytic streptococcus

Bact. coli, Cl. welchii, anaerobic streptococci

Three of the organisms commonly causing puerperal sepsis are normally found in or near the genital tract. *Bact. coli* is constantly, and *Cl. welchii* is sometimes, found in the faeces, and anaerobic streptococci have been found in the vagina of 30 to 40 per cent of normal women during pregnancy (Rosowsky; Soule and Brown; and White). Infections by these organisms are therefore probably in most cases autogenous.

Staphylococcus

Staphylococcus is rare in the normal vagina, nor does it live in the faeces. It is, however, so widely distributed and so rare as an infecting agent in puerperal sepsis that it is hard to determine the source of any particular infection. There is some probability that the nose may be an important source.

Pneumococcus

Pneumococcus is not normally found in the genital tract, and, on the rare occasions on which it is found there, it is almost certainly derived from the respiratory tract.

Haemolytic streptococcus

It is with the haemolytic streptococcus, the cause of most of the severe infections, that the greatest confusion has arisen about the source of infection, and it is only since the introduction of Lancefield's method of dividing these organisms into groups that the position has become fairly clear.

Vagina

In a total of nearly 5,000 normal women, Taylor and Wright, and Rose found that haemolytic streptococci were present in the vagina of about 3 per cent. Of 855 women examined at the beginning of labour at Queen Charlotte's Hospital twelve (1·4 per cent) had haemolytic streptococcus in the vagina. In this investigation certain streptococci were neglected on account of some special cultural characteristics. If they had been included, the figure would have probably been in close agreement with the 3 per cent of other workers. Of these twelve strains of haemolytic streptococcus none was a member of group A, and they were therefore relatively non-pathogenic. This is supported by the fact that eleven of the patients had an afebrile puerperium, whereas the twelfth, who harboured a group B streptococcus, although febrile was not seriously ill. Further, out of the 843 cases with no haemolytic streptococci at the beginning of labour, six developed moderately severe haemolytic streptococcal infections in the puerperium. Four of these six streptococci were of group A; the other two were lost before being grouped but were almost certainly group A strains. These results, although not quite conclusive on account of the small numbers, suggest that group A haemolytic streptococci are rarely, if ever, present in the normal vagina.

Group A strains

Respiratory tract

Incidence of carriers

The respiratory tract is a common breeding-ground for haemolytic streptococci. Various workers have found carrier rates among normal individuals ranging from 3 to 30 per cent. About one-third of these may be expected to belong to Group A (Hare); therefore 1 to 10 per cent of the population may carry potentially pathogenic haemolytic streptococci in the respiratory tract.

Investigations into the importance of these respiratory tract infections in the causation of puerperal sepsis have been carried out by Smith (1931, 1933), Paine (1931, 1935), Dora Colebrook (1935), and others. These workers, dividing the streptococci into types by agglutination and agglutinin absorption reactions, found identical types in the genital tract of the infected patient and in the respiratory tract of some contact or of the patient herself in 89 out of 118 cases investigated. Since there are 24 or more distinct serological types in the group A streptococci, such figures indicate a very high probability that the infecting genital strain was derived in most of these cases from the related strain in the respiratory tract.

Other sources

Septic foci

Smith and Dora Colebrook showed that the infecting streptococcus in four of their cases was apparently derived from some other septic focus. In three this was a septic finger, one on the patient, one on the medical attendant, and the third on a child in the house who was not present at the delivery; in the fourth case the focus was a septic lesion on the patient's foot.

Skin

The skin as a source of infection has been studied by Colebrook, Maxted, and Morris Johns, who isolated group A haemolytic streptococcus from the skin of the hands in 7 out of 181 normal individuals. Five out of these 7 gave a history of recent colds or catarrh, and the hands in these cases were possibly infected from the nose by the handkerchief. Testing the skin in other parts of the body, these authors failed to find group A streptococci on the skin of the interscapular region of 14 persons, and swabs from the skin of the perineum and the peri-anal region of 160 pregnant women also gave negative results. Further, Colebrook and Maxted showed that haemolytic streptococci implanted on the skin disappeared spontaneously in a few hours. It appears therefore that the skin is only of importance as an intermediate carrier, and not as a primary source of pathogenic haemolytic streptococci.

Faeces

Haemolytic streptococci are fairly common in the faeces, but, as on the skin, they seldom belong to group A. Hare and Maxted found haemolytic streptococci in the faeces of 29 out of 100 women in the first stage of labour, but none of these was a member of group A. Out of 50 cases of scarlet fever, however, they isolated group A streptococci from no less than 10. They conclude that group A streptococci are unusual in the faeces in the absence of an active infection of the respiratory tract.

(*c*) *Transference of Infection to Genital Tract*

Salivary spray

Range of transference of droplets

Paine (1935) proved that haemolytic streptococci could be ejected from the throat in salivary droplets. In 10 of 14 subjects known to harbour the organisms in the throat without clinical signs of infection a positive result was obtained when the culture medium was placed a few inches from the mouth, but when the distance was increased to 10 inches there was only one positive result. He concluded that the momentum of the droplets is low, and that they are not likely to travel far in a horizontal direction. This suggests that direct infection of the vulva by salivary spray is rare.

Transference of droplets to hands

Hands, gloves, and instruments, however, may be readily infected by these low momentum droplets and in this way carry the infection to the genital tract. Infections of the nose are less likely to be spread in this way, but the hands in such cases are sure to be infected by the handkerchief and, unless strict and efficient antiseptic technique is maintained, may carry the infection to the genital tract. The patient's hands may be important carriers of infection, especially when she has an infection of the nose. This may explain many of the infections in unassisted labours.

Dust

Survival of streptococci in dust

The importance of dust as an intermediate carrier of haemolytic streptococci has been shown by Cruickshank and by White (1936). White, examining twenty-three single-bedded rooms in which patients with haemolytic streptococcal infections were nursed, found haemolytic streptococci in the dust in every room. In nearly all the rooms these proved to be of the same serological type as the patient's infecting strain. It was further shown that haemolytic streptococci could survive in dust for at least ten weeks, and their virulence for mice was found to be unimpaired after twenty-five days. During the investigation severe throat infections arose in two of those helping in the work, and in each case the infecting strain was serologically identical with that in the room which was being investigated. There is therefore clear evidence that dust can be infected, and that human infections can be caused by infected dust. Transmission by dust may explain infections arising from remote sources, such as infective foci in the patient's husband or children who are not present at delivery.

Haematogenous infection

Infections from the patient's respiratory tract are thought by some to be carried by the blood-stream. Some support for this view is found in the work of Okell and Elliott, who showed that *Streptococcus viridans* was sometimes found in the blood in severe cases of pyorrhoea, especially after extraction of teeth. But there is no positive evidence for such a spread of the haemolytic streptococcus, and many blood cultures from known throat carriers have given negative results. Spread by the blood-stream must be excessively rare, if it occurs at all.

(4)—Morbid Anatomy

Types of lesion

The morbid changes induced by puerperal sepsis are similar to those found in other inflammatory reactions. Their nature and extent depend on the virulence of the organism, the site of the lesion, and the defensive reactions of the affected tissues. For practical purposes three types of infection must be recognized.

(*a*) *Localized Lesions*

Wounds

Visible wounds

Lacerations may heal aseptically by first intention or display the usual features shown by septic wounds elsewhere. They fall into two groups, namely visible wounds and invisible wounds. Visible infected wounds of the perineal and the vulval skin and, to a lesser extent, of the vaginal wall become reddened, tender, hot, and swollen. They may appear indolent and unhealthy, or they may lead to sloughing and suppuration.

Invisible wounds

Puerperal wounds may be inaccessible and invisible, and, unless the birth canal is carefully inspected, their existence may be overlooked. Lacerations of the vagina can hardly be missed if a thorough examination is carried out, but injuries of the corpus uteri cannot be detected by ordinary inspection, and the placental site is always hidden from view unless the uterus is inverted.

Clinical features

Cervical and vaginal lacerations present the usual features common to all ragged and infected wounds, but injuries of the birth canal are but slightly tender unless the skin or the peritoneum is also involved. Such wounds may give rise to primary or secondary post-partum haemorrhage, to a sanious or purulent discharge which may contain sloughs, and to a variable degree of general disturbance—fever, increased pulse-rate, and headache, due to the absorption of toxins.

Complications: endometritis

The defenceless state of the vagina and open cervical canal favours extension of infection upwards into the cavity of the uterus and explains the frequency of septic endometritis. When organisms gain entrance into the uterus, the primary attack falls upon the lining membrane, but some involvement of the muscular wall is inevitable. The most dangerous area is the placental site (which is most accessible in cases of placenta praevia), but the lumina of the tubes are also open to attack by direct continuity. In cases of moderate severity the infection is limited to the uterus, and the general disturbance depends on the degree of sapraemia present.

Sapraemia
Cause

Sapraemia is due to the presence of necrotic putrid material inside the uterus. Absorption of these products causes toxaemia and produces a fairly characteristic train of signs and symptoms. There is tenderness in the lower abdomen over the area of the enlarged and subinvoluted uterus. The lochia are profuse and offensive, containing clots and small sloughs. There is moderate general disturbance due to the absorption of toxins, but serious reactions, such as rigors, are rare, and their appearance generally indicates the spread of the infection beyond the sapraemic stage.

In simple sapraemia the placental site is protected by the leucocytic barrier, and, so long as this barrier remains intact, there is little chance of generalization. If, on the other hand, this area is subjected to trauma, the natural defences may be broken down and organisms gain access to the deeper tissues. This risk affords a powerful argument against unnecessary exploration of the uterus and must always be borne in mind when adherent and infected placental remnants are being removed.

Treatment

Sapraemia generally responds rapidly to skilful antiseptic treatment, but good drainage must be provided if pyometra is to be avoided.

Pyometra

Pyometra, the collection and retention of pus in the uterine cavity, may arise in three ways: (i) the heavy puerperal uterus may fall backwards and kink the cervical canal; (ii) the cervical canal may be plugged by the accumulation of decidual and placental debris; and (iii) rarely the canal may be blocked by a cervical polyp or fibroid, or the cervix may fail to dilate after Caesarean section in a primigravida operated upon before labour has begun.

Clinical picture

The recognition of pyometra is not difficult so long as the clinician bears the possibility in mind. The syndrome includes enlargement and tenderness, i.e. painful distension of the uterus, intermittent offensive uterine discharge, escape of pus from the cervical canal during manipulation of the uterus, and striking response to drainage.

Treatment

Drainage is essential but must be effected without damage. Careful manual exploration, the injection of glycerin, and the use of intrauterine douches are practically free from risk so long as the uterus is unruptured and the operator possesses the necessary skill and caution. A rigid instrument or, worse still, a sharp one, such as a curette, should never be introduced into the parturient uterus except by an expert, and few experts are prepared to carry out this hazardous operation.

(*b*) *Spreading Lesions*

Spreading

In spreading lesions the infecting agent may extend beyond the initial boundaries: (i) by direct extension along the lumen of the birth canal, causing endometritis, salpingitis, and peritonitis, (ii) by extension along fascial planes and through cellular tissues and lymphatics, generally as a result of injury, setting up cellulitis, lymphangitis, cystitis, or other conditions; and (iii) through the blood, leading to thrombophlebitis.

Direct spread along the birth canal

Puerperal salpingitis

The puerperal type of salpingitis generally sets in at the end of the first week of the puerperium and runs a subacute course. The clinical signs resemble those of other forms of salpingitis but with certain differences that are peculiar to the puerperal state. Since the tubes during the puerperium are abdominal rather than pelvic in position, the peritoneum of the general abdominal cavity is more readily involved by the inflammatory process. The general symptoms, such as fever, vomiting, and abdominal pain, are therefore more severe. The physical signs show a corresponding variation, the inflamed and swollen tubes being palpable in the iliac fossae but out of reach of vaginal examination.

The characteristic feature of ascending salpingitis is the bilateral character of the physical signs. This feature, however, is never manifest at the onset of the infection, and in puerperal cases it is apt to be obscured by the clinical signs of peritonitis. The differential diagnosis then lies between salpingitis and peritonitis due to some other cause, such as injury to the corpus uteri or an infected tumour.

Puerperal peritonitis

Peritonitis may arise in several ways during the puerperium: from direct spread of the organisms along the lumen of the tube; through infected penetrating wounds of the uterus and vagina; or from independent organic disease or accident, such as perforation of the bowel, uncommon but most important events which must not be forgotten.

The clinical picture is modified by the puerperal condition of the patient. Pelvic peritonitis is rarely restricted to the pelvic cavity but involves the peritoneal lining of the false pelvis and the lower abdomen. There is a much greater likelihood of local peritonitis becoming generalized. Generalized infections are extremely dangerous, and the clinical picture tends to be atypical, especially in the septicaemic type, in which a little free fluid and slight abdominal distension may be the only indications of peritoneal involvement.

All forms of peritonitis increase the gravity of the immediate outlook and cause much permanent disability in patients who survive the original attack.

Spread of infection through tissue spaces and lymphatics: cellulitis

Cellulitis

The uterus and upper part of the vagina are closely related to the cellular tissue which fills the base of the broad ligament. This parametric tissue is readily opened up by injuries of the lateral wall of the uterus and is also accessible through deep lacerations of the cervical canal and vaginal fornices. The resulting infection is essentially subacute and due to invasion by organisms of low virulence, because the dangerous organisms pass rapidly through the connective tissue without exciting any defensive reaction and thus attack the deeper parts of the body before the characteristic features of cellulitis have had time to develop.

The physical signs of cellulitis may be recognizable in the second week of the puerperium, but they often pass unnoticed for several weeks after delivery.

Subacute cellulitis

In mild and otherwise uncomplicated cases there is little systemic disturbance, and the condition comes to light during the routine examination of a patient suffering from puerperal pyrexia. The physical signs are characteristic. The inflammatory changes begin round the site of injury; the affected parts are tender and thickened, without any well-defined edge, and of a boggy consistence. Extension follows along the planes of the pelvic fascia and may eventually invade a considerable portion of the cellular tissue. Careful vaginal and rectal palpation will enable the extent of the involvement to be mapped out.

Chronic cellulitis

Chronic cellulitis arises in two ways: (i) subacute cases may fail to respond to treatment and become chronic; and (ii) the condition may be observed for the first time many weeks or even months after childbirth. These 'ambulant' cases doubtless begin during the puerperium, but the systemic disturbance is so slight that the patient disregards the symptoms until the persistence of vague general ill-health, anaemia, and debility induces her to seek advice.

The involvement may be partial and limited to one side of the pelvis, or it may be so complete as to surround the uterus, bladder, rectum, and vagina with an infiltration which obliterates all anatomical landmarks and gives the impression that the pelvic organs are embedded in plaster of Paris. The consistence of inflammatory exudates of this type increases with time until resolution sets in or suppuration takes place. Resolution means the disappearance of the inflammatory reaction, but this process is rarely complete, and some residual thickening is usual. (See also CELLULITIS, PELVIC, Vol. III, p. 15.)

Lymphangitis

Phlegmasia alba dolens, commonly known as 'white leg', is a lymphatic type of subacute cellulitis. The walls of the larger lymphatics are inflamed, and their lumina are obstructed by the surrounding inflammatory exudate. This gives rise to a solid type of oedema. Sometimes the veins are also compressed, or there may be associated phlebitis and thrombosis; thus a mixed type of oedema may be produced which is partly lymphatic and partly venous in origin.

For the treatment of such patients rest is essential: the limb should be elevated and kept warm, and soothing dressings should be applied locally. The causal cellulitis should also receive attention. There is but slight chance of embolism so long as the obstruction is limited to the lymphatic field, but special care is necessary whenever there is evidence of venous thrombosis. The swelling of the tissues is apt to persist for months in spite of treatment, and in some women there is a slight permanent enlargement of the limb. When the acute stage has subsided, it is of advantage to recommend exercise, massage, and an elastic support.

Local spread of infection by the blood-stream

Thrombophlebitis

Normally the clotting of blood in the vessels of the puerperal uterus and pelvis is slight, and clots are limited to the mouths of the vessels of the placental site, an obviously protective mechanism that reduces the frequency of puerperal embolism. In the presence of injury and infection, however, excessive clotting may take place, and various types of thrombophlebitis may follow. This process affects the large veins of the pelvis and the lower limbs and even the vena cava and thus may give rise to various clinical pictures. There may be sudden death from embolism or merely transitory oedema due to aseptic thrombosis of the veins of the leg, but in all cases the clot affords a potential medium for the spread of infection.

Thrombophlebitis of pelvic veins

Thrombosis in the pelvic veins is protective in so far as the clot interposes a barrier to the ingress of organisms, but the clot may be invaded and penetrated by virulent organisms and become a source of pyaemic abscesses.

Femoral thrombophlebitis

Infection of the femoral veins is the mildest and the most chronic type of puerperal thrombophlebitis, although the condition may give rise to embolism. The thrombosis may be due to extension from a pelvic focus, or it may arise *de novo* in any part of the venous system of the limb, the site of origin being determined by local conditions, such as varicosity, injury, or pressure. The left leg is attacked more often than the right owing to the anatomical disposition of the rectum and of the great vessels at the bifurcation of the aorta, which imposes an undue amount of pressure upon the left common iliac vein. In all cases there are an element of infection and a small but definite risk of generalization, especially pyaemia.

The incidence of phlebitis may be reduced by regular muscular and respiratory exercises during the puerperium, elimination of haemorrhage, injury, and infection, changes of posture during the lying-in period, and regular and efficient evacuation of the bowels.

(*c*) *Generalization*

Invasion of the blood-stream demonstrates failure of the defensive systems of the body to resist the attack of pathogenic organisms. It implies high virulence in the organism or lack of general and local resistance in the patient or a combination of both factors. It may assume three forms:

Primary septicaemia

(i) In primary septicaemia entrance to the blood-stream is effected through the placental site or an open wound, and the organisms rapidly pass to all parts of the body, including the reticulo-endothelial system. In fulminant cases there is complete absence of both general and local resistance, and necropsy reveals few tissue changes beyond cloudy swelling, oedema, and the presence of organisms throughout the tissues and fluids of the body. The clinical features include early onset, absence of localized physical signs, and rapid appearance of grave general symptoms.

Secondary septicaemia

(ii) Invasion of the blood-stream may be a secondary or terminal event in the later history of any type of severe puerperal infection. In such cases the clinical and pathological picture is modified by the presence of those localized and spreading lesions which have preceded and caused the general invasion.

Pyaemia

(iii) In pyaemic states the invasion of the blood-stream is not only secondary but intermittent. It is due to the escape of septic emboli from a local or spreading focus of infection and their transport through the blood-stream to distant parts of the body, where they cause pyaemic abscesses. These inflammatory changes or abscesses and the freedom from blood invasion between the attacks of embolism demonstrate the existence of both general and local resistance and distinguish pyaemia from the secondary form of septicaemia. The clinical picture of pyaemia may assume many forms, in conformity with the site, number, and duration of the pyaemic abscesses, but the latter always constitute a characteristic and easily recognizable pathological feature.

(5)—Course and Prognosis

The clinical and surgical pathology of puerperal fever is determined, on the one hand, by the virulence of the organism, its portal of entry, and mode of spread and, on the other, by the state of the local and general defences of the body. As already pointed out, localized puerperal infections tend to spread, and spreading lesions may become generalized, and it is therefore unnecessary to emphasize the potential gravity of every case.

The probable course and prognosis cannot be estimated until the patient has been carefully examined and an accurate differential diagnosis made.

(6)—Clinical Examination and Diagnosis

Diagnosis must be based upon a careful clinical examination which must be as thorough as the general condition of the patient will permit; each system of the body must be investigated for signs of disease. The mental state, condition of the tongue, and quality of the pulse are of first importance. Special attention must be paid to the abdomen, and any physical signs or symptoms discovered there must be correlated with the history of labour and the subsequent train of events.

Diagnosis of associated diseases

The clinician must remember that overwhelming toxaemia is bound to obscure and may almost obliterate the ordinary signs of peritonitis, and that the onset of extragenital disease, such as pneumonia and appendicitis, may be modified by the puerperal state of the patient.

Localization of signs

The physical signs of local lesions arising in any part of the birth canal tend to involve the whole of that structure but to be restricted to it, whereas the effects of spreading lesions, in the absence of general

Toxaemia, septicaemia, and pyaemia

septicaemia and the profound toxaemia which may precede the septicaemic state. In such cases the issue can only be decided by a blood culture, although a quick response to antitoxin treatment is highly suggestive. The recognition of pyaemia presents no difficulty, for the significance of embolic abscesses can hardly be missed.

(8)—Treatment

(*a*) *Prevention*

Autogenous infections

Conditions necessary for growth of organisms

The steps necessary for the prevention of infection differ according to the nature of the infecting organism. Three of the common organisms, the anaerobic streptococcus, *Bact. coli*, and *Cl. welchii*, are normally present in the vagina or in the rectum (see p. 385). These three have another common characteristic, namely, the inability to grow freely in blood or serum except when this has been altered by the accumulation of acid products of metabolism or by proteolytic ferments liberated by the breakdown of leucocytes. These conditions are found when tissues have been devitalized by injury, and it is generally only after difficult deliveries with considerable trauma that severe anaerobic streptococcus or *Bact. coli* infections occur. The chance of infection is still further increased if there has been much manual interference, with the consequent risk of carrying organisms from the vulva or vagina into the uterus. The prevention of infection by such organisms depends therefore largely on improved obstetric technique and the avoidance of manual interference and injury as far as possible.

Exogenous infections

The prevention of infection by organisms not normally present in or near the genital tract, of which the haemolytic streptococcus is by far the most important, presents certain special features, since here it is necessary to stop every possible source of infection and to prevent organisms from entering the genital tract.

Risks in hospitals and nursing homes

The danger of infection must depend to some extent on the surroundings in which delivery is conducted. In the case of institutional deliveries there is little doubt that a well organized maternity hospital offers the best chance of safety. In a maternity department attached to a general hospital there must always be a slight risk of spread of infection from surgical wards, but in favourable circumstances this risk may be small. The position is rather different in the case of nursing homes, and the risk in a small home taking maternity and general medical and surgical cases must be considerably greater, since reasonable segregation of the maternity staff is often impossible in the more limited accommodation.

In patient's home

In the case of deliveries in the patient's home there is again a certain risk, on account of the difficulty of controlling the possible source of infection. Such conditions cannot compare for safety with those in a maternity hospital where regular sterilization of wards can be carried out and strict control kept on all who enter the labour wards.

Prevention at the source

All possible sources of haemolytic streptococcus infection must be looked for; although the respiratory tract is the commonest, other septic sites are sometimes responsible. Anyone with a history of recent sore throat or of catarrh, or who has been recently in contact with septic cases should be examined bacteriologically and, if found to be carrying haemolytic streptococci, banished from the house. Since it may be impossible to exclude all sources with certainty, everyone attending the patient at delivery and during the first few days at least of the puerperium should wear an *efficient* mask, covering the nose and mouth. Ideally, the patient should also wear a mask during delivery. This may be difficult in practice, but when a patient has any signs, or a recent history, of sore throat, every effort should be made to persuade her to wear a mask. The number of cases in which the infection has apparently come from the patient's respiratory tract is disturbingly high.

Masks

Treatment of intermediate carriers

Prevention of infection by intermediate carriers mainly depends on scrupulous cleanliness and careful use of efficient antiseptics. The possibility must always be remembered that haemolytic streptococci may be lurking in dust, towels, bed linen, or basins used for washing, and because of their resistance to drying these organisms may have been derived from some source of infection which is no longer in evidence. All dust must be removed from the delivery room before labour begins if possible, and after that should be left undisturbed. If dusting must be done, a damp cloth should be used. All unnecessary hangings or ornaments which collect dust should be removed before labour begins.

Antiseptic technique

For the rest, efficient antiseptic technique forms the final barrier against infection. There are several important requirements which an antiseptic must fulfil if it is to be regarded as efficient. Of these, the most important are: (i) it must act rapidly, against the particular organisms likely to cause infection; (ii) its activity must not be impaired too much by serum or other protein-containing substance; and (iii) it must confer a lasting resistance to reinfection on hands or gloves sterilized by its means.

Dettol

Many antiseptics fail to fulfil the second condition, notably the solutions of mercurial salts, but it is the third condition which rules out the majority. Colebrook and Maxted, in an exhaustive investigation of antiseptics, found only two which conferred this resistance to reinfection, iodine and dettol, the latter being a proprietary preparation the active principle of which is a chlorinated xylenol. Gloves sterilized in full-strength dettol cannot be infected by haemolytic streptococcus within five hours, and if 30 per cent dettol cream is used the resistance lasts for three hours. This resistance to infection is of such paramount importance in obstetrics, in which gloves may have to be worn for many hours under conditions in which complete surgical asepsis may be impossible, that no antiseptic which fails to provide such protection should be used. If gloves are sterilized first with dettol cream and then resterilized on the hands every two hours, the danger of carrying infection to the vulva will be reduced to a minimum. Attention has been drawn above to the danger of infection from the patient's hands, and safety can here be achieved by smearing them with dettol cream before, and at regular intervals during, labour.

(*b*) *Specific Chemotherapy*

Most of the formerly vaunted remedies have not justified their promise, but there is now every reason to hope that at last a specific form of chemotherapy is available against the haemolytic streptococcal infections. This specific chemotherapy was first introduced by Domagk in 1935 in the form of the azo-dye called prontosil. Since then a number of different forms of the drug have been produced, the simplest of which, *para*-aminobenzenesulphonamide, or sulphanilamide, has appeared on ~~or a~~ market under various trade names.

ulphon- mide

the Prolonged clinical trial of these drugs during two and a half years has shown a 75 per cent decrease in the death-rate of patients suffering from haemolytic streptococcal infection, a number of surprising recoveries in apparently moribund patients, and a great reduction in the incidence of complications with a consequent decrease in the average length of stay in hospital.

Dosage For mild infections 1 gram of sulphanilamide by mouth three times a day is generally sufficient. This may be increased to 1·5 or 2 grams thrice daily in more severe cases. In some of the most severe infections it may be advisable in addition to give one of the more soluble forms of the drug, e.g. prontosil soluble, by intramuscular injection, or a solution of 0·8 per cent of sulphanilamide in physiological saline may be given intravenously by continuous drip.

It is important to start treatment early in the disease, but bacteriological control of the case is strongly advised, since the drug occasionally shows some toxic effects. It is therefore not wise to administer it to all infected patients indiscriminately and without regard to the infecting organism.

Toxic effects Of these toxic effects, the most common is cyanosis, associated with sulphaemoglobinaemia or methaemoglobinaemia. The patient's colour may cause much alarm, but it is seldom necessary to stop the administration of sulphanilamide for this reason alone if the patient's condition otherwise warrants further treatment; but in patients with severe anaemia the cyanosis may be a more serious matter. Occasional nervous symptoms have been seen, such as paraesthesia, dizziness, diplopia, and sometimes mental confusion. The most serious toxic effect, fortunately rare, is agranulocytosis. Fourteen such cases have been reported in the literature, and of these nine have died. Severe anaemia, sometimes fatal, has also been recorded. Because of these blood changes it is wise to make routine blood counts every two or three days in all patients who have been taking sulphanilamide for more than ten days without a satisfactory response, or who show a secondary rise of temperature while under treatment.

For a fuller account of these drugs and their possible toxic effects, the reader is referred to the work of Colebrook, Kenny, and Purdie; Discombe; Foulis and Barr; Garrod; Harvey and Janeway; and Jennings and Southwell-Sander.

(*c*) *Sera and Vaccines*

Serum

Antitoxic sera enjoyed a protracted vogue that was scarcely justified by the recorded results, but they have lost much of their popularity, and some recent workers have suggested that they may be harmful. This view is not shared by all, and I have seen cases which appeared to be greatly improved by administration of multivalent serum or streptococcus antitoxin (scarlet fever). Their use, however, should be controlled in the following ways: (i) the serum or antitoxin should be given early, if possible as a prophylactic and certainly before the stage of bacteriaemia has been reached; (ii) the initial dose should be small, but, if there is apparent improvement, the treatment should be repeated in 24 hours and the dosage increased; (iii) if, after administration of a reasonable dose, there is no definite improvement, the treatment should be discontinued; and (iv) when it is proposed to give repeated doses of serum, precautions should be taken against anaphylaxis.

Vaccines

Vaccines do not play any part in the control of acute infections but can be tried in subacute and chronic cases. Vaccine therapy should always be carried out in conjunction with a bacteriologist.

(*d*) *Surgical*

Indications

The conditions requiring or justifying surgical intervention have already been indicated and correlated with the underlying surgical pathology. These methods may be divided into minor and major procedures.

Minor procedures

Wounds of perineum and vagina

Accessible wounds in the perineum and vagina must be dealt with in accordance with their degree and situation. Free drainage must be provided. Antiseptic dressings must be applied and incisions made for the evacuation of pus.

Uterine lesions

Infected wounds of the cervix should be treated on the same principles, but treatment is more difficult on account of the anatomical situation. Medicated vaginal packs impede drainage, and douches are liable to carry infected material upwards into the cervical canal, but gentle vaginal medication may safely be carried out. High cervical lesions or injuries of the corpus uteri are best left alone, although the cautious instillation of glycerin is recommended for selected cases.

Exploration of uterus

The merits and demerits of exploration of the uterus and the risks of unnecessary or unskilful interference have already been referred to (see p. 394). This method should never be employed as a routine; but, if there is reason to suspect ruptured uterus, pyometra, or retention of placental products, exploration should be carried out. The discovery of sapraemia and pyometra indicates the need for removal of placental debris and for the provision of adequate drainage. Drainage may be achieved by the insertion of a large rubber tube held in position by two silkworm-gut sutures passed through the side of the cervix or by intravenous douching or instillation of glycerin.

Pelvic abscess A localized pelvic abscess must be incised as soon as the diagnosis is made, but it is dangerous to make a prolonged search for a doubtful collection of pus. Pelvic abscesses are often accessible through the floor of the recto-uterine excavation (pouch of Douglas), and posterior colpotomy is a simple and safe procedure.

Lesions elsewhere Occasionally it may be necessary to employ surgical methods for localized infections in the abdomen and for abscesses in more remote parts of the body, but, unless the infection is pointing at the skin, such operations should only be undertaken by experienced surgeons.

Major surgical procedures Major operations play little if any part in the treatment of acute puerperal sepsis, although they may be required in subacute and chronic cases.

Laparotomy The value of laparotomy has aroused much controversy, and the matter is still *sub judice*. This operation has been recommended for acute septicaemia, pelvic phlebitis, and tubal abscess.

Abdominal drainage for acute septicaemia Abdominal drainage for acute septicaemia, quickly carried out by a highly trained surgical and nursing team, with the insertion of one or more drainage tubes into the lower abdomen and pelvis may be of therapeutic value and can do little harm; but under anything less than the best conditions it is dangerous and unjustifiable. Moreover, the early abdominal signs of septicaemia—free fluid and slight distension—are equivocal, and therefore the exponents of early interference may unwittingly perform an unnecessary operation. On the other hand, if operation is delayed until the presence of peritonitis is beyond doubt, the provision of drainage may be too late to save the patient. Unless the clinician has the necessary skill and experience and reasonable surgical facilities are available, laparotomy is calculated to do more harm than good.

Ligature of pelvic veins Recovery after excision of infected pelvic veins has been recorded on several occasions. It is impossible to diagnose this condition with any certainty, and excision is therefore not recommended.

Salpingo-oophorectomy Laparotomy for tubal infection should not be undertaken in the acute stage unless there is clear evidence of the presence of localized pus under tension and it is impossible to reach the abscess by the vaginal route. In such circumstances it may be necessary to open the abdomen and to incise the tubal abscess. The evacuation of pus should be carried out with a minimum of disturbance to the surrounding adhesions, and, although the tubes should be freely incised, they should not be removed at the primary operation. Later, in the stage of convalescence of such patients and for the treatment of chronic cases not previously operated upon, radical excision may be necessary, either salpingo-oophorectomy alone or with hysterectomy.

Excision of the uterus for acute sepsis is an operation of great severity and hardly ever justifiable. In septicaemia the general condition of the patient offers little hope of recovery after an operation of such magnitude; for milder conditions the risk of operation may be less, but it is still greater than that attaching to conservative measures. Hysterectomy should therefore be reserved for very special occasions, and it may be justifiable in conjunction with Caesarean section performed for ruptured uterus, concealed accidental haemorrhage, or obstructed labour, when there is grave reason to suspect dangerous infection of the uterus prior to operation ('suspect Caesarean section'). Later in the puerperium or post-natal period hysterectomy may have a limited application for localized abscesses in the uterine wall and for infected tumours. *Hysterecto*

(e) Symptomatic Treatment

Treatment must be based on data derived from the initial clinical investigation, the results of laboratory investigation, the subsequent progress of the patient, and her reaction to treatment. Good nursing, fresh air, and nourishment are essential. If these cannot be obtained at home, the patient should be removed to hospital.

Blood transfusion is clearly advisable for exsanguinated and dehydrated patients; when this is impracticable, saline, glucose, and alkalis may be given intravenously and by other routes. Narcotics and sedatives are especially useful for restless and sleepless patients, and stimulants may be required to tide some women over a period of sudden emergency or collapse. Among the many drugs which may be useful are quinine, ergot, iron, calcium, and nucleic acid. Special symptoms must be dealt with as they arise and in accordance with their underlying pathology.

After-care When the attack of puerperal sepsis has subsided, attention must be paid to the remote results of infection and special treatment instituted for the relief of residual symptoms arising from such lesions as cervical laceration or erosion, uterine displacement, and chronic pelvic infection. There can be no doubt that much of the permanent disability now resulting from puerperal sepsis might be reduced, if not entirely averted, by treatment in the post-natal period.

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PULMONARY DISEASES

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PULMONARY VALVE DISEASES

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PULSUS ALTERNANS

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PYELITIS

SECTIONS 1 TO 6

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Reference may also be made to the following titles:

BLADDER DISEASES
COLIFORM BACILLUS INFECTIONS
CONVULSIONS IN INFANCY AND CHILDHOOD
PREGNANCY

1.–DEFINITION

1330.] The term pyelitis denotes an infection of the renal pelvis. Though infection is rarely limited to the renal pelvis, pyelitis is a useful term for those cases in which the kidney is only slightly affected, the inflammation chiefly affecting the renal pelvis.

2.–AETIOLOGY, PATHOLOGY, AND MORBID ANATOMY

Initial lesion

The only lesion found in the early stage of pyelitis is congestion and catarrh of the renal pelvis, the wall of which is thickened and possibly ulcerated. This comparatively slight change causes so much disturbance because the renal pelvis and ureter are not merely passive channels for the urine but are equipped with muscular walls which by their contraction pass the urine to the bladder. Inflammation of the renal pelvis causes urinary stasis, because it interferes with the

Urinary stasis

natural peristalsis of the pelvis and ureter. Stasis in turn aggravates and prolongs the inflammation.

Obstruction

Any pathological condition which causes retention of urine within the renal pelvis may predispose to pyelitis. Obvious examples are calculous disease of the kidney, malformations of the pelvis, and obstructions of the ureter. The pyelitis of pregnancy (see p. 416) is usually secondary to a dilatation of the ureter. Pyelitis in children is often associated with distension or malformation of the urinary passages.

In morbid conditions such as these the infection can be explained by the lowered resistance of an imperfect organ, but in many cases no gross abnormality can be found in the kidney or the ureter. When infection occurs in an apparently normal kidney, it is possible that there may have been some functional defect which available methods of observation have failed to detect.

Routes of infection

Both in cases with and without obvious structural defect the question arises how the bacteria responsible for the infection reach the kidney. There are three possible routes: blood-stream, lymphatics, and ureter.

(1)—Blood-Borne Infection

Excretion of bacteria by kidneys

In most cases of pyelitis the infection is brought to the kidney by the blood-stream. This occurs in many generalized infections, such as septicaemia and enteric fever; and excretion by the kidney appears to be one of the ways in which the body rids itself of bacteria. Probably bacteria often reach the kidney also in minor infections and are excreted without causing any noticeable injury. When no known source of bacterial infection can be discovered, it is often assumed that the bacteria, particularly *Bact. coli*, must have reached the kidney by the blood-stream from the intestinal tract.

(2)—Lymphatic Spread

Periurethral lymphatics

Proof of spread of infection to the kidney by lymphatic channels is provided both by experimental and by clinical observations. Bacteria may pass up the periurethral lymphatics to the perinephric tissues and then through the renal capsule to the cortex and thence to the renal pelvis (Walker). This may sometimes be the channel of infection when pyelitis occurs as a complication of urethritis or of cystitis.

Possible route from colon

It is possible also that communications may exist between the lymphatics of the colon and those of the kidney. The frequency with which renal infections are caused by intestinal bacteria and the close proximity of the colon and kidney strongly suggest this.

Initial lesions of blood-borne and lymph-borne infections

In both haematogenous and lymphatic infections the first lesions are found in the cortex of the kidney and consist of small foci of suppuration. The pelvis is not affected until the bacteria have passed down the tubules. The disease is therefore essentially a pyelonephritis, at any rate in its early stages. Later, when the infection becomes firmly established in the renal pelvis, the pelvic wall is plum-coloured, and its mucosal surface is swollen and oedematous and may be studded with vesicles and haemorrhages. At this late stage of the disease it is not possible from examination of the kidney to decide whether the infection was haematogenous or lymphatic in origin, nor even to distinguish it from an advanced stage of infection by the ascending route.

(3)—Ascending Infection

This results from infection from the lower urinary organs and is the last phase of many chronic diseases of the bladder and urethra, such as malignant growths, enlarged prostate, and urethral stricture. It may follow operations on the bladder or the passage of instruments.

Predisposing conditions

Two conditions predispose to ascending infections along the ureter, which are unlikely to occur unless one of them is present. The first is dilatation of the ureter. The ureter penetrates the wall of the bladder obliquely, its longitudinal layer of muscle passing into the trigonum. A natural barrier to upward extension of infection is provided by this manner of insertion of the lower end of the ureter into the bladder. When the bladder is distended, the trigonum is pushed down and the bladder wall stretched, with the result that the intramural portion of the ureter becomes more oblique and flattened. When the bladder is contracted, the intramural portion of the ureter becomes shortened and less oblique, but the mucous membrane is thrown into folds which prevent a reflux of fluid (Thomson-Walker). If this valve-like protection at the lower end of the ureter is lost from disease of the bladder or the dilatation of the ureter, regurgitation of urine takes place when the bladder contracts. This results in a further dilatation and thickening of the ureter with upward spread of infection along the stagnant column of urine within the ureter.

Dilatation of ureter

Renal disease

The second factor determining ascending infection is disease of the kidney. Obstructive lesions of the lower urinary tract result in hydronephrosis and degenerative lesions in the kidney. These in their turn predispose to infection.

Ureter

The inflammatory process of an ascending infection affects the ureter and renal pelvis before the kidney, the ureter being usually dilated, its wall thickened, and the mucous membrane swollen and congested. Microscopically the submucosa shows an inflammatory exudate and the muscular coat fibrosis. Similar changes are found in the renal pelvis, the wall of which may be much thickened and fibrotic. The renal pelvis becomes dilated with turbid urine, and its mucosa shows patches of haemorrhage and ulceration.

Renal pelvis

Renal lesions

The renal lesions depend on the stage of the disease; at first the renal papillae are flattened and show streaks of pus along the course of the collecting tubules. Later these unite and form wedge-shaped areas of suppuration in the medulla and rounded abscesses in the cortex.

(4)—Bacteriology

Bact. coli

By far the commonest bacterium in pyelitis is *Bacterium coli*. In most cases this organism is present in enormous quantity, imparting a faint turbidity or sheen to the urine when held up to the light. The urine may have a fishy smell. The reaction is usually acid with *Bact. coli* infections and alkaline with infections by *Proteus vulgaris* or by *Pseudomonas pyocyanea*. In the early stages of *Bact. coli* infection microscopical examination of the urine shows many bacteria and very few pus cells; but, when the infection becomes well established, pus is usually present to the extent of several cells per microscopic field. Bacteriological cultures made from one drop of urine result in a profuse growth of the infecting bacteria.

In routine bacteriological tests on the urine it is customary to label as *Bact. coli* all Gram-negative non-sporing bacilli which do not liquefy gelatin but ferment lactose. A more detailed study of these bacilli shows that they may be divided into many subgroups by the ordinary tests used for the classification of bacteria. For instance, Hill and his co-workers subjected to detailed bacteriological analysis 200 cultures of Gram-negative bacilli isolated from genito-urinary infections. These 200 cultures could be divided into 65 different types on the basis of their fermentation and biochemical reactions. Only half of the 200 strains corresponded to the classical description of *Bact. coli commune*. These and other similar studies show that there is in most cases no obvious correlation between the clinical condition of a patient and particular types of *Bact. coli*; their subdivision therefore has no clinical interest at present.

Attempts have been made to distinguish between the pathogenic and non-pathogenic strains of *Bact. coli* by the haemolysis test, which has proved useful for streptococci, haemolytic strains of streptococci being generally more virulent than non-haemolytic strains. No definite relation between pathogenicity and haemolytic activity has been established for *Bact. coli*, as was shown by Dudgeon, Wordley, and Bawtree, who found that about 70 per cent of *Bact. coli* infections in males and only about 30 per cent in females were due to haemolytic strains.

One atypical coliform bacillus, however, is often associated with a characteristic clinical picture. This is a subvariety which ferments lactose very slowly and is therefore known as a late lactose fermenter. In infections with this organism the urinary manifestations may be masked at the onset by a severe general reaction leading to a clinical diagnosis of enteric fever. This is due to the fact that the pyrexial period is longer and more severe than in a true *coli* fever. In spite of the severity of the initial symptoms complete recovery tends to ensue, and the urine clears up spontaneously. The bacilli responsible for these infections are usually actively haemolytic. Specific agglutinins are formed in the blood of patients with these infections. The acute febrile illness is believed to be due to an inflammation of the urinary passages which causes partial or complete obstruction to the outflow of urine (Dudgeon and Pulvertaft).

3.–CLINICAL PICTURE AND COURSE

The intricate relation between the pelvis and the rest of the kidney makes it impossible to differentiate sharply between pyelitis and pyelonephritis. An additional difficulty in the description of pyelitis is the great difference in character of the clinical forms. Pyelitis may occur as a fulminating dangerous intoxication, as an acute inflammation, or as a mild chronic infection. It is therefore necessary to consider three types: hyperacute or fulminating; acute; and subacute and chronic. *Clinical types*

(1)—Hyperacute or Fulminating Type

Onset The most noticeable feature of this clinical type is the sudden onset. The patient, who has previously been in good health, is seized with a rigor, and the temperature mounts to 104° or 105° F. Signs of severe toxaemia rapidly develop, and the patient may become drowsy or even comatose in a comparatively short time. Vomiting is common, as are also abdominal pain and rigidity. The urine is scanty and may even be suppressed. *Course* So rapid may be the progress of the disease that the patient may die in coma before the renal origin of the intoxication is discovered.

(2)—Acute Type

Onset As in the fulminating cases, the first sign is often a severe rigor. The patient complains at first of general abdominal pain, which later settles in the loins as a persistent ache. Abdominal palpation reveals a tender swollen kidney, but sometimes muscle rigidity is so great that it is impossible to palpate the kidney. The urine is scanty and contains albumin. Microscopical examination shows the presence of leucocytes, red blood-corpuscles, and organisms. Hyaline, granular, and blood casts are also often seen.

Course The course of the disease is variable. Usually after falling slightly the temperature shoots up again with a repetition of the rigor. After two to three weeks of fever the acute symptoms subside, and the temperature falls, but it is liable to rise again when the patient is allowed up. These relapses are very common and are due either to infection of the hitherto sound kidney or to a recurrence in the kidney originally attacked. Although ultimate recovery is the rule, a few cases instead of running a benign course end fatally, the temperature rising to 105° or even 107° F., rigors becoming more frequent, and signs of renal failure, such as a dry tongue, scanty urine, and hiccup or vomiting, appearing. Finally the patient's mind becomes dull and clouded, and he sinks into coma.

(3)—Chronic Type

Onset

Usually this is a sequel to an acute attack, but sometimes a pyelitis is insidious and chronic in its onset. This is more likely to occur in an ascending pyelitis secondary to a lesion in the lower urinary tract than in a blood-borne infection. In either event, whether the pyelitis is haematogenous or ascending, the chief symptoms are often vesical rather than renal, the patient complaining of chronic bladder irritation and frequency of micturition. Nocturnal polyuria is very characteristic of chronic pyelonephritis. The urine is abundant, pale, faintly acid, and hazy. On standing the pus settles down as a dense creamy deposit at the bottom of the glass. The urine often has a fishy or even an ammoniacal smell and contains pus cells, bladder epithelium, and organisms.

Ascending infection

In ascending infections, preceded by long-standing obstruction, the kidneys may have already been severely damaged, and there are consequently signs of renal insufficiency. In these cases of so-called urinary septicaemia the patient presents a sallow earthy appearance with a dry harsh skin, and, whatever measures are adopted, it is often impossible to induce sweating. The tongue, at first only dry, later becomes glazed and cracked, and from absence of saliva the lips, buccal mucous membrane, and throat soon become uncomfortable. There are nausea and loss of appetite with obstinate constipation. The patient at first complains of a frontal headache but later becomes listless and has to be roused to take liquid or food. The loss of weight persists, and generally the temperature remains subnormal. Occasionally the chronic condition is interrupted by an acute exacerbation, with a fleeting rise of temperature and an increase of renal tenderness, that subsides again into the chronic toxaemia. Chronic septic pyelitis may continue for several years, the patient finally being restored to health by the relief of his urinary obstruction and the successful treatment of his sepsis, or else dying of uraemia. In the latter event the output of urine generally falls, and the headaches, nausea, and drowsiness increase until the patient sinks into a coma that is, as a rule, undisturbed by uraemic convulsions.

Course

4.–DIAGNOSIS AND DIFFERENTIAL DIAGNOSIS

Fulminating type

The differential diagnosis of pyelonephritis varies with the type of case. In the fulminating type the symptoms are those of a sudden and profound toxaemia; a differential diagnosis must be made from a toxaemia due to other causes, e.g. acute influenza, hepatic or subphrenic abscess, and lobar pneumonia, by examination of the urine and abdominal palpation, unless the abdominal pain has produced so much rigidity that the swollen tender kidney cannot be palpated.

In the less acute type the diagnosis is usually easier. Careful palpation of the abdomen reveals the renal enlargement and tenderness, and microscopical examination shows that the urine contains pus and organisms. Sometimes, however, the differential diagnosis is more difficult. If abdominal rigidity is pronounced and the patient has vomited, the condition may simulate appendicitis. In such a case a careful examination for the points of maximal tenderness will help in distinguishing between the two diseases. Maximal tenderness in pyelitis is in the loin and anteriorly at a point midway between the costal margin and the umbilicus at the edge of the rectus muscle. In appendicitis the most sensitive area is over McBurney's point. Cystoscopy is not advisable in the presence of appendicitis but can, if necessary, be performed in cases in which the differential diagnosis still remains in doubt.

Diagnosis from appendicitis

The other acute abdominal diseases simulated by an acute renal infection are cholecystitis, intestinal obstruction, and a ruptured ulcer. As in acute appendicitis, the differential diagnosis is reached by a careful investigation of the area of maximal tenderness and by the absence or presence of urinary symptoms and of pyuria. As a last resort cystoscopy may be undertaken.

Chronic type

In chronic pyelitis the commonest error is to regard the secondary cystitis as primary and to overlook the renal infection. This can be avoided by cystoscopic examination (see Vol. V, p. 25) followed, if necessary, by catheterization of the ureters. Cystoscopy shows that the ureteric orifice on the affected side is surrounded by a halo of congestion or even of oedema, and that the efflux is cloudy. When these changes are not apparent, an examination of the urine collected by ureteric catheterization proves that the kidney on that side is infected. Intravenous pyelography may also show changes on the affected side, i.e. dilatation of the pelvis or of one or more of the calices.

5.–PROGNOSIS

In mild cases of acute pyelitis the prognosis is good, complete recovery without operation being the rule. It is only in the fulminating type or in chronic urinary septicaemia that the outlook is grave. In fulminating pyelonephritis nephrectomy is often necessary to save the patient. The prognosis of chronic pyelitis is better in the haematogenous than in the ascending types. When the infection is grafted on to a kidney already damaged by obstruction, the outlook depends on the state of the kidney and the probability of dealing satisfactorily with the obstruction. In long-standing cases permanent renal damage has taken place, and complete recovery cannot be effected.

6.–TREATMENT

(1)—Prophylaxis

Ascending infection

This applies more particularly to acute ascending pyelitis, e.g. from catheterization or from the passage of other instruments along the lower urinary tract. To prevent this, asepsis and gentle manipulation

Blood-borne infection are of the greatest importance. Blood-borne infections of the kidney are prevented best by the avoidance of chilling, over-fatigue, and constipation.

(2)—Cure

(*a*) *Acute Pyelitis*

Acute pyelitis, once established, requires prompt treatment. If the patient is able to retain fluids, large draughts of warm Contrexéville or of barley-water should be given to provoke diuresis. Thomson-Walker recommended for the same purpose the use of theobromine and sodium salicylate (diuretin) in doses of 10 to 15 grains four-hourly. In severe cases associated with vomiting fluids must be introduced by other means, i.e. by the rectum, subcutaneously, or intravenously. Lumbar pain is relieved by hot fomentations, poulticing, or dry cupping. It is always important to open the bowels and to combat abdominal distension. A dose of castor oil is probably the most effective measure, unless the patient has already begun to vomit, in which event an enema must be used.

Alkalis Large doses of potassium citrate or of sodium bicarbonate to render the urine alkaline have long been a routine measure in the treatment of coliform infections of the urinary tract, and, although many of the ideas on which this treatment was originally based have been revised, treatment with alkali during acute stages of an infection may still be useful, if for no other reason than that it increases the patient's comfort. As soon, however, as the acute symptoms have passed, better results are obtained by more modern remedies, such as sulphanilamide and calcium, sodium, or ammonium mandelate.

Operation There are two circumstances in which recourse should be had to surgical treatment in acute pyelonephritis: for the relief of urinary obstruction in the lower urinary tract, and to drain or to remove an inflamed kidney. When medical treatment in an acute case proves insufficient and improvement does not begin within three or four days, or should the patient lose ground before this time, an operation may be necessary. Unrelieved obstruction should always first receive attention, the simplest effective procedure for achieving this being chosen, e.g. a *Nephrostomy* suprapubic drainage for an enlarged prostate. Nephrostomy is generally sufficient for the relief of a severe renal congestion and sepsis, the kidney being incised along its convex border and a rubber drain introduced into the pelvis through the renal substance. It is only in the *Nephrectomy* exceptional fulminating type that nephrectomy is necessary. When, however, the patient, in spite of all treatment, appears to be losing ground, there should be no hesitation in sacrificing the heavily infected kidney, provided that the opposite kidney appears to be reasonably sound.

(*b*) *Subacute and Chronic Pyelitis*

This may be either a sequel to an acute attack or primary, either haematogenous or ascending. It is important to examine the patient carefully for any possible primary source of infection and to treat this energetically. In a haematogenous pyelitis the commonest situations for the primary focus are the bowel, gall-bladder, appendix, and throat; in ascending infection the bladder and prostate. Since urinary obstruction is often present in an ascending infection, it is also important to deal adequately with strictures, prostatic obstruction, and urinary calculi.

Primary focus

The existence of an ascending infection calls for special caution in performing any operation. For this reason the least possible should be done, the bladder being opened and drained suprapubically for an enlarged prostate and an external urethrotomy carried out for a stricture. When the obstruction is in the ureter, better drainage is sometimes provided by an indwelling ureteric catheter, through which renal lavage may be carried out. If the infection and the obstruction are both severe, e.g. a heavily infected hydronephrosis, a temporary nephrostomy may sometimes be necessary.

Removal of obstruction

After the obstruction has been dealt with, the infection should be attacked by making the urine an uncongenial medium for bacterial growth. This may be done with urinary antiseptics or by the administration of such drugs as mandelic acid and sulphanilamide. It may also be achieved by a ketogenic diet.

Alteration of urine

For the limitations of treatment by means of urinary antiseptics see Vol. III, p. 283. It is generally felt that all urinary antiseptics have proved unsatisfactory, whether given by the mouth or injected intravenously. Either such antiseptics are inert, or else they are only effective in such large doses as to produce harm. Indeed of the host of urinary antiseptics introduced the only drug that has in any way stood the test of time is hexamine pushed until it begins to produce signs of bladder irritation.

Urinary antiseptics

The ketogenic diet (see Vol. V, p. 115), mandelic acid, and sulphanilamide have proved far more satisfactory. For success with the ketogenic diet the patient's urine must contain ketone bodies. A rapid method of testing for the presence of these substances is to add 8 to 10 drops of a 10 per cent solution of ferric chloride to 3 to 6 c.c. of urine. If acetoacetic acid is present, the characteristic dark red colour appears, but a somewhat similar reaction occurs in the urine of patients taking preparations of salicylic acid, such as aspirin. The acidity of the urine must be increased to at least *p*H 5·2, and to effect this it may be necessary to administer orally 6 grams of ammonium nitrate daily in the form of 12 enteric-coated pills or tablets of 0·5 gram each.

Ketogenic diet

Test for ketone bodies

Any deviation from the prescribed diet will retard recovery. Sufficient exercise to aid in oxidation of the fat will assist in developing a ketosis. The ketogenic diet does not always succeed in sterilizing the urine. When infection is well established and considerable renal injury has already taken place, the patient may be unable to excrete enough ketone bodies or sufficiently acid urine to inhibit bacterial growth. The urine from an infected kidney may remain neutral or only faintly acid, while the urine from the unaffected kidney may reach the desired degree of acidity (Clark).

Mandelic acid

A further advance in the treatment of urinary infections was achieved when Rosenheim in 1935 discovered the antiseptic properties of mandelic acid. This substance is non-toxic to man and in an acid urine exerts a powerful antiseptic action. (See also Vol. III, p. 285.) Mandelic acid was first given in neutralized solution with eight 1-gram cachets of ammonium chloride to render the urine acid. The treatment was modified by Holling and Platt, who found that by using ammonium mandelate the urine could usually be satisfactorily acidified without the use of any additional ammonium chloride. Ammonium mandelate is very hygroscopic and is therefore generally used in the form of a sweetened syrup. Rosenheim recommended 3 grams (45 grains) of mandelic acid in the form of syrup of ammonium mandelate four times a day after meals. The fluid intake should be reduced to two pints a day. It is essential to make certain that the urine becomes sufficiently acid. This is shown by the production of a pink colour with methyl red indicator, a 1 per cent solution of the dye being used for this purpose. For testing the urine about 5 drops of the indicator are added to about 1 inch of urine in a test-tube. The optimal effect of mandelic acid treatment is produced when the methyl red gives a slightly pink colour to the urine. Throughout the treatment the maintenance of this tint when 5 drops of methyl red solution are added to 2 c.c. of urine is desirable. The appearance of a yellow tint on addition of the indicator to the urine shows that the urine is too alkaline, and that ammonium chloride must be administered or the diet altered. If the urine changes to a deep pink, there is an excess of acid, and the ammonium chloride may be decreased.

When the patient is taking ammonium mandelate, it is usually unnecessary to give ammonium chloride to acidify the urine.

The following method of prescribing mandelic acid may be useful.

No. 1.

Ammonium chloride – –	– 20 grains
Syrup of orange – –	– 30 minims
Distilled water – –	– to ½ ounce

Dose: ½ fluid ounce 6 times daily, followed by

No. 2.

Mandelic acid – –	– 45 grains
Sodium bicarbonate –	– 24 grains (or sufficient to neutralize the acid)
Syrup of lemon – –	– 30 minims
Distilled water – –	– to 1 ounce

Dose: 1 fluid ounce 6 times daily between meals.

In children

For children of four years of age or over 2 grams (30 grains) of sodium mandelate and 1 gram (15 grains) of ammonium chloride every six hours have been found suitable. For children of 1 to 4 years the dose should be 1 gram (15 grains) of sodium mandelate and 0·6 gram (10 grains) of ammonium chloride every six hours. The ammonium chloride may be dispensed as a mixture with liquorice according to the following formula:

Ammonium chloride	10 grains
Liquid extract of liquorice	10 minims
Distilled water	to 1 ounce

Another method of giving mandelic acid and ammonium chloride is as follows:

Mandelic acid	45 grains
Sodium bicarbonate	21 grains
Syrup of orange	1 drachm
Distilled water	to 1 ounce

Dose: 1 fluid ounce in water 4 times a day.

Appropriate doses of ammonium chloride are given in cachets containing 10 grains. Six cachets in the day are usually sufficient to secure the desired acidity with this prescription, but larger doses may sometimes be necessary. The fluid intake is limited to between two and three pints a day to ensure a strong concentration of the mandelic acid in the urine.

Calcium mandelate

Some patients find it hard to tolerate sodium mandelate and ammonium chloride, and in these circumstances calcium mandelate may prove more acceptable. Schnohn recommended a powder containing about 70 per cent of calcium mandelate. This is obtainable under the name of camygdal. One level dessertspoonful contains approximately 2 grams of mandelic acid. The calcium mandelate is broken down in the stomach to form mandelic acid and calcium chloride. The preparation is tasteless, seldom causes dyspeptic symptoms, and provides sufficient acidity in the urine.

Sulphonamide compounds

A further advance in the treatment of urinary infections followed the discovery of the antiseptic action of sulphonamide compounds. The preparation sulphanilamide (*p*-aminobenzenesulphonamide) has proved very effective in sterilizing the urine (Kenny, Johnston, and von Haebler). Sulphanilamide (80 c.c. representing 1 gram) or prontosil soluble (5 per cent solution) may be given by intramuscular injection. Sulphanilamide may also be given by mouth (4 to 8 tablets representing 2 to 4 grams). The great advantage of this drug over mandelic acid is that it may be given in acute cases and does not require the administration of accessory acid or the restriction of fluid. By a prompt injection followed by an oral administration an acute pyelitis may often be brought to a rapid end. This statement applies not only to streptococcal infection but also to infection with coliform bacilli. In less acute cases oral administration is sufficient to sterilize the urine. The treatment should be continued for a week. During this time no saline purges or sulphates should be given. Indeed purgatives of all sorts with the exception of liquid paraffin should be avoided, because evacuation of the bowel associated with watery stools tends to increase the absorption of sulphides from the bowel and to cause sulphaemoglobinaemia (see Vol. III, p. 520, and Vol. V, p. 158).

7.–PYELITIS OF PREGNANCY

(1)—Aetiology

Incidence

1331.] Pyelitis is a common complication of pregnancy, its frequency being about 1 per cent.

Causation

Bacilluria

Dilatation of ureters

Elongation of ureters

Atonia of ureters

Pyelitis during pregnancy differs from that occurring at other periods of life mainly because of the presence then of special aetiological factors which determine its onset, course, and prognosis. The two main predisposing factors are bacilluria, which is present in 11 per cent of pregnant women (Dodds, 1931), and changes in the ureters, which are dilated in about 80 per cent of pregnant women. The enlargement is asymmetrical, greater on the right than on the left side, and most pronounced from the renal pelvis to the brim of the true pelvis, but may extend downwards as far as the ureteric orifice in the bladder. Dilatation is accompanied by elongation, and as a result the ureters are thrown into curves and displaced laterally. Diminution in tone of the ureters is most pronounced during the fifth and sixth months of pregnancy and gradually diminishes towards full term. The cause of the atonia is believed to be either excess of corpus luteum hormone or diminution of posterior pituitary hormone.

Hypertrophy of ureters

Other aetiological factors probably play a minor part. Hypertrophy of the lower third of the ureters was believed by Hofbauer to be the cause of the dilatation of the ureters, but this is unlikely, because the dilatation is asymmetrical and rarely extends below the level of the brim of the pelvis.

Pressure on ureters by uterus

The right ureter is more laterally placed than the left, crosses the iliac vessels at an acute angle, and is therefore more exposed to pressure than is the left ureter, which is protected by the promontory of the sacrum and by the sigmoid mesocolon. This may account for the greater dilatation of the right ureter. Further the right ureter is more liable to pressure than the left, for the commonest foetal position is the left occipito-anterior, which brings the oblique diameter of the foetal head into close contact with the right ureter at the brim of the pelvis.

Dextro-rotation of the uterus with consequent stretching of the left and kinking of the right ureter is of doubtful aetiological significance, as are also shallowness of the right renal fossa, which is liable to be associated with prolapse of the right kidney and consequently with kinking of the right ureter; pre-existing ureteral stricture, believed by Hunner to be present in cases of pyelitis; and incomplete emptying of the bladder when it becomes an abdominal organ in the later months of pregnancy.

Route of infection

There is still no satisfactory proof of the route of infection, but it most probably occurs by the blood-stream, since there is considerable evidence against either an ascending or a lymphatic route of infection. The organism most commonly found is *Bact. coli.*

(2)—Clinical Picture and Course

The onset of pyelitis usually occurs between the fourth and the sixth months of pregnancy. The presence of the enlarged uterus makes the examination of the patient and the diagnosis difficult. The kidney is rarely palpable; but, if it is, it is enlarged and tender. There are three clinical types: acute, acute toxic, and subacute.

(*a*) *Acute Type*

Onset

The onset is sudden, with severe paroxysmal pain in one, usually the right, or both loins. Rigors may occur. The temperature is high, pulse rapid, respiration shallow, tongue furred, and the patient acutely ill. Frequency of micturition and rarely dysuria are present. Considerable rigidity and tenderness, at first diffuse but later localized to the costovertebral angle, are elicited on palpation of the affected side of the abdomen. The acute stage lasts a few days in most cases, and then the symptoms disappear, but investigation of a series of cases showed that the infection persisted for the remainder of the pregnancy in a quiescent state and was liable to acute exacerbations (Dodds, 1932). The recent advances in treatment have resulted in the cure of a high percentage of cases. In those cases in which the acute stage is more prolonged, fever is higher, and rigors are more frequent, the disease has most probably spread from the renal pelvis into the parenchyma of the kidney. Treatment of this condition is difficult, and the ultimate prognosis is not good. About 30 per cent of the patients go into premature labour in the acute stage of pyelitis.

Course

(*b*) *Acute Toxic Type*

In this form the toxaemic symptoms predominate. The onset is more gradual. Nausea, prostration, vomiting, jaundice, rarely delirium or mania, and a prolonged acute stage with later a secondary anaemia are the outstanding features. The signs and symptoms met with in the acute type are present to a lesser degree.

(*c*) *Subacute Type*

This is probably the commonest form in pregnancy. The patient complains of general weakness, tiredness, and inability to carry out her usual duties, an aching pain in her back or loins, and occasionally frequency of micturition. She may complain that her urine is cloudy and has a bad smell. The temperature is rarely above 99° F. and the pulse-rate only slightly increased. Tenderness may be elicited in the costovertebral angle on deep pressure. A trace of albumin is present in the urine, and microscopically organisms and pus cells are found.

(3)—Prognosis

In a series of cases investigated over a period of years (Dodds, 1932) the following conclusions were reached: (i) the immediate prognosis is good; (ii) unless specific measures are adopted, very few patients are cured in the sense that the urine is sterile on culture before delivery; and (iii) pyrexia lasting for more than sixteen days during pregnancy is associated with a bad remote prognosis; 60 per cent of these patients subsequently develop a chronic inflammation.

(4)—Diagnosis and Differential Diagnosis

The differential diagnosis varies with the type of disease, but in all cases the diagnosis is made by finding organisms and pus cells on microscopical examination with a darkened field and a $\frac{1}{6}$-inch lens of a single drop of a fresh uncentrifuged catheter specimen of urine.

(*a*) *Acute Type*

The diagnosis is made from the following, among other conditions which may complicate pregnancy.

Diagnosis from biliary and renal colic

Biliary and renal colic may be diagnosed by (i) a history of old-standing disease; (ii) a history of typical attacks of biliary or of renal colic; and (iii) X-rays, including cholecystography and pyelography.

From onset of premature labour

If premature labour has set in, the pain synchronizes with the uterine contractions, there will most probably be a blood-stained discharge from the vagina, and on examination *per vaginam* a dilating os is found.

From basal pneumonia

Basal pneumonia in its early stage may closely simulate an acute pyelitis. The onset may occur with a rigor, pain referred to the hypochondrium, high temperature, increased pulse-rate, and rapid and shallow respirations. Careful clinical examination will also show acting alae nasi, a cyanotic tinge of the face, and possibly an area of hyperaesthesia over the shoulder along the cutaneous distribution of the fourth cervical nerve. If physical signs in the chest are not present at the first examination, they will usually be found twenty-four hours later. Examination of the urine will settle the diagnosis.

From acute appendicitis

Acute appendicitis occurring at or after the fifth month of pregnancy presents a difficult problem, especially when the appendix is retrocaecal. Since this disease has a high mortality during pregnancy, every hour's delay in operating is serious. The careful clinical history of the onset and course are of great assistance. In appendicitis pain is at first generalized over the whole of the abdomen, followed by vomiting, and later localized to the right side. The patient, except during an attack of pain, does not appear acutely ill. The temperature and pulse-rate are only moderately raised, and rigors are rare. When the patient comes under observation, the pain is generally localized to the right side of the abdomen. The anterior abdominal wall may move on respiration. An area of hyperaesthesia may be found in Sherren's triangle, and rigidity and tenderness may be present in the costovertebral angle. Consideration of these points, a history of a previous attack of appendicitis, and examination of the urine will assist the diagnosis. The two diseases may co-exist.

From red degeneratio in a fibroid

Red degeneration in a fibroid is not uncommon in pregnancy. The onset may be sudden, accompanied by vomiting, pain in the abdomen, and slightly raised temperature and pulse-rate. Examination will show that the pain is localized to one area in the uterine wall.

(*b*) *Acute Toxic Type*

From hyperemesis gravidarum

This must be differentiated from other causes of toxaemia, especially from hyperemesis gravidarum. Hyperemesis occurs at or before the third month of pregnancy and is gradual in onset, starting as morning sickness and increasing in severity. The temperature and pulse-rate are only slightly increased in the early stage.

(*c*) *Subacute Type*

Lumbago, sacro-iliac or lumbosacral strain, and general debility can be differentiated by examination of the urine. Nephritis is differentiated by a raised blood-pressure, oedema, and the absence of organisms and pus cells in the urine.

(5)—Treatment

The treatment of pyelitis of pregnancy is similar in many ways to that of pyelitis at other times, and the reader is referred back to first part of this article (p. 412) for details of drugs, prescriptions, and other forms of treatment (see also COLIFORM BACILLUS INFECTIONS, Vol. III, p. 283). This section deals with the additional points in treatment during pregnancy.

The acute stage of pyelitis of pregnancy is treated symptomatically by fluids and alkalis.

Sulphonamide compounds

Ammonium mandelate

The known tendency to persistence of inflammation for the remainder of pregnancy makes it necessary to render the urine sterile after the subsidence of the acute attack. This is achieved in most cases by treatment for one week with one of the sulphonamide preparations, 0·5 gram thrice daily. When a bacilluria persists at the end of a week, 0·5 gram twice daily for two days every fortnight should be given until the urine becomes sterile or until the termination of pregnancy. When no response to treatment with sulphonamide compounds is obtained in the subacute stage, ammonium mandelate should be given, provided that the temperature is not above 100° F. and that there is only a trace of albumin in the urine. A normal temperature is obtained by alkali treatment. This may also decrease the amount of albumin in the urine. A careful watch should be kept on the amount of albumin during mandelic acid treatment, for an irritative nephritis may occur. Most patients respond to one or other of these methods of treatment.

Ketogenic diet

If they are unsuccessful, and the temperature is normal, a ketogenic diet may be given in an attempt to render the urine sterile.

When the temperature remains high in spite of adequate treatment by alkalis and sulphonamide compounds, the following further lines of treatment may be adopted.

(i) Compression of the ureter may be relieved by lying on one or other side, by lying on the back with the knees flexed, by resting on the hands and knees, or by having the foot of the bed raised and the pillows removed.

(ii) The ureters can be drained by ureteral catheterization. Since the infection is frequently bilateral, both ureters should be catheterized and drained. The pelvis of the kidney may be washed out by injection of saline or weak antiseptic solution and the catheter kept patent by four-hourly injections of a few cubic centimetres of saline. The temperature subsides, as a rule, on the second day after insertion of the catheter. The length of time the catheters are left in depends on how rapidly the inflammation responds to drainage. When the ureters are grossly enlarged and atonic, the response is less rapid than when the ureters are only slightly enlarged and of good tone. The catheters should be removed when the temperature has been normal for forty-eight hours.

When catheterization of the ureters is impossible, e.g. when the foetal head is engaged in the pelvis, 2 units of pituitary (posterior lobe) extract may be given at hourly intervals for six hours to stimulate ureteric contractions. This method should only be adopted under personal medical supervision, because there are the dangers of tetanic uterine contractions and of premature induction of labour.

8.–PRIMARY PUERPERAL PYELITIS

(1)—Aetiology

1332.] Pyelitis occurring in the puerperium may be either a primary infection in the puerperium or an acute exacerbation of an antenatal pyelitis. Urinary infections are responsible for 8 to 10 per cent of the notifiable pyrexias in the puerperium and occur in 1·6 per cent of deliveries. A primary puerperal pyelitis differs in its aetiology, clinical features, course, and prognosis from antenatal pyelitis.

Route of infection

Experimental work and clinical observation show that the infection most probably ascends from the bladder to the pelvis of the kidney. The causal factors are (i) the high incidence (17 to 20 per cent of cases) of retention of urine in the puerperium, and (ii) reflux of urine from the bladder into the atonic ureters.

(2)—Clinical Picture and Course

The onset occurs, as a rule, between the eighth and tenth days and is characterized by a sudden rise in temperature, with or without rigors. Urinary symptoms, i.e. frequency, retention, or dysuria, are present in less than half the cases. Pain in the loin may be complained of, but usually this is slight and transitory. On examination there are few clinical signs pointing to a kidney infection. Costovertebral tenderness may be present in a few cases. The pyrexia usually lasts a few days.

(3)—Prognosis

The ultimate prognosis in puerperal pyelitis is good. The inflammation clears up earlier, and there is not the same tendency to chronicity as with antenatal pyelitis.

(4)—Treatment

The same general lines of treatment as those used in pyelitis of pregnancy are followed (see p. 419). Most cases clear up after a few days' treatment with alkalis or with sulphanilamide.

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PYELONEPHRITIS

See PYELITIS, p. 404

PYKNOLEPSY

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Reference may also be made to the following title:
EPILEPSY

1.–DEFINITION

(*Synonym.*—Multiple little attacks of childhood)

1333.] This disorder of childhood is characterized by very frequent attacks identical with the mildest type of *petit mal* but considered by some to be distinct from epilepsy by reason of a much more favourable prognosis.

2.–HISTORY

Friedmann first described the syndrome in 1906, although he used the unfortunate title of 'non-epileptic absences or short narcoleptic attacks'. It has since become clear that the condition is not related to narcolepsy. The name 'pyknolepsy' was suggested by Sauer in 1912; it refers to the extreme frequency of the attacks (πυκνός, compact, dense) and has been adopted by all subsequent writers. A considerable literature, largely German, has accumulated on the subject, but there is obviously much confusion with the more classical types of epilepsy, and the clinical picture is even now far from being clearly defined as a separate entity.

3.–AETIOLOGY AND PATHOGENESIS

The cause of pyknolepsy is entirely unknown. In those cases which conform strictly to the syndrome as described by Friedmann it appears that an epileptic heredity is even rarer than in frank epilepsy. Some authors lay stress on emotional factors in precipitating attacks, but it is certain that the condition cannot be classified as mainly hysterical.

No patient has died from uncomplicated pyknolepsy, and nothing is known concerning the pathological basis of the syndrome.

4.–CLINICAL PICTURE

Onset

The onset is described as occurring invariably between the fourth and twelfth years. Friedmann stated that the onset was nearly always 'explosive', the maximal number of daily attacks appearing at once: this feature is held to be one of the points of distinction from 'true' *petit mal*, in which the earliest attacks are usually infrequent.

Attack

The sole symptom is the attack, of which the essential feature is a sudden disturbance of consciousness lasting not more than ten to twenty seconds and often less. It is said that this differs from 'epileptic absence' in that the loss of consciousness is incomplete, although it is admitted that the degree of unconsciousness varies. Voluntary movement and speech are interrupted; the limbs relax, the child stares vacantly, but automatic movements may continue, for example walking or even running may not be interrupted. During the attack a certain contact with the surroundings is usually maintained; thus if the child continues to walk he may avoid obstructions, but this is not invariable, and he may run into danger. Objects are rarely dropped from the hands. Some patients fall during an attack, but if so it is said they fall slowly and do not hurt themselves. Some of the patients can remember what has happened during an attack, but in others impairment of consciousness is deeper and memory is lost during the attack.

Often the eye-balls roll upwards, and flickering of the eyelids may occur: the head may be turned to one side, and there may be slight lifting of the arms; but no clonic or convulsive movements of any kind occur, and, though there may be slight flushing or pallor, there are no cyanosis, no salivation, and no chewing or swallowing movements. The confusion that exists is exemplified by the fact that some authors describe the occurrence of incontinence, snoring, and stiffness of the body, whereas others regard such features as entirely excluding pyknolepsy.

Frequency of attacks

The frequency of the attacks varies from six to one hundred a day but tends to be fairly constant in the individual. A most important

Uniformity

feature is the uniformity of the attacks: Adie described their 'extraordinary monotony'. Immediately the brief attack is over the child becomes normal, drowsiness, headache, and automatism being entirely absent.

Apart from the attacks these children are perfectly well and show none of the physical or mental deterioration so often observed in the subjects of classical epilepsy.

5.–COURSE AND PROGNOSIS

Relation to epilepsy

As described by Freidmann, Heilbronner, Adie, and others, the most important feature of pyknolepsy is that, after lasting for periods varying from a few weeks to several years, the attacks cease as abruptly as they began and never recur. Unfortunately it is upon this fundamental point that there is so much difference of opinion. An analysis of 166 cases, 36 personally observed and the others from the literature, showed that 52 were cured, 34 developed epilepsy, and 80 were still subject to pyknoleptic attacks after periods of fifteen years or more (Rosenthal). Allowing for the many possibilities of error in diagnosis by the admission of cases not strictly conforming to type, it is still clear that some cases of pyknolepsy develop convulsive epilepsy in course of time. I have seen a case conforming precisely to the syndrome from the age of 8 to 23. Two attacks with incontinence of urine were then reported. In the following year, at the age of 24, the patient had her first major epileptic seizure. The occurrence of cases of this kind must be held to invalidate the generalization that pyknolepsy differs from epilepsy in having an invariably favourable prognosis. Pyknolepsy is almost certainly a variety of epilepsy, but, if the attacks are of the uniformly mild character described above, it is justifiable to give a better prognosis than in the average case of epilepsy. In such cases the attacks cease spontaneously with a greater frequency than in the more classical forms of the disease.

6.–DIAGNOSIS AND DIFFERENTIAL DIAGNOSIS

There appears to be no difficulty in recognizing cases of the type described. The sudden onset in childhood, the extremely transient character of the attacks, their frequency, their monotonous uniformity, and the absence of any physical or mental deterioration form a distinctive picture.

Diagnosis from epilepsy

The difficulty is to know whether they can be distinguished from epilepsy. So far as the individual attack is concerned, it is certain that no such distinction can be made; but, if the complete syndrome as described remains entirely uniform under observation, it seems justifiable to conclude that the case falls into the clinical category of pyknolepsy, an important conclusion because it implies an unusually favourable prognosis.

There is apparently a tendency to distinguish pyknolepsy by the mere frequency of attacks: it is, however, more probable that the essential feature of the syndrome is the very mild character of the attacks, and it may be this which accounts for the retention of otherwise normal health.

7.–TREATMENT

Since at the onset distinction from *petit mal* is impossible, it is certain that the treatment should be that of epilepsy in general (see Vol. V, p. 113). Most of those who have described this syndrome, however, have found that bromide and phenobarbitone have little or no effect on pyknolepsy, and they have urged this observation as a further argument against the identity of the syndrome with epilepsy. Whether this argument is sound or not does not alter the obvious necessity of a trial of the usual anti-epileptic remedies.

Benefit in pyknolepsy has been claimed for ephedrine ¼ to ½ grain twice daily.

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PYLORIC OBSTRUCTION

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Reference may also be made to the following titles:

ACHALASIA STOMACH DISEASES

1.–HYPERTROPHIC STENOSIS OF THE PYLORUS

(1)—Definition

(*Synonym.*—Congenital hypertrophy of the pylorus)

1334.] Hypertrophic stenosis of the pylorus is a disease of unknown origin, appearing in the first few weeks of life, and characterized by remarkable hypertrophy of the circular muscle of the pylorus, sufficient to form a palpable tumour in the abdomen and to obstruct the outlet of the stomach. As a result persistent and forcible vomiting follows which, if unchecked, causes death from inanition.

(2)—Aetiology

Sex and family incidence

Age of onset

Diet

Several interesting peculiarities in this disease are worthy of mention. It is particularly a disease of boys. Of 836 consecutive cases at the Hospital for Sick Children, Great Ormond Street, 84 per cent were boys. First children of the family are commonly affected: 60 per cent were first-born. More than one child in a family may have the complaint, and twins may suffer together; in one family three children were affected. The commonest age of onset is three weeks, but the symptoms have been known to begin in the first week of life and as late as the twentieth week. Diet does not appear to have any influence on its causation: the condition is found with equal frequency in breast-fed and in bottle-fed infants. The social status of the family has no relation to its occurrence, for its incidence is as frequent in private as in hospital practice.

Hypotheses of causation

Spasm

Achalasia

Its cause is unknown. Many hypotheses have been formulated, but none explains every aspect. Spasm alone would not cause the striking hypertrophy and hyperplasia of the circular muscle which may be found a few days after birth. Undoubtedly most cases of pyloric stenosis have some degree of spasm, and treatment of this is of benefit, though it has little effect on the hypertrophy. Achalasia—neuromuscular incoordination—explains the failure of the normal reflex movements of the stomach but hardly accounts for the anatomical changes.

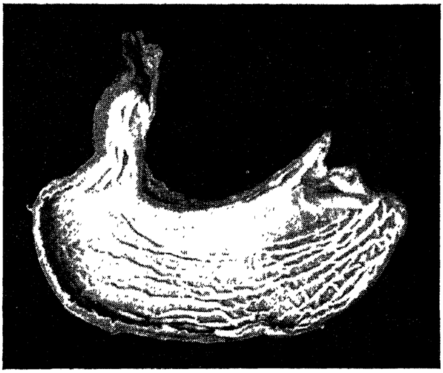

FIG. 28.—Hypertrophic stenosis of pylorus

Hyperplasia of muscles

(3)—Morbid Anatomy

The characteristic feature of the malady is hypertrophy of the pyloric muscle. The circular fibres show great hyperplasia and hypertrophy, and the pyloric canal forms a hard almost cartilaginous tumour 1 to 1½ inches in length (see Fig. 28). The peritoneal coat is tense and unyielding, and as a result the increased bulk of muscle within occludes the lumen of the canal, compressing the mucous membrane into longitudinal folds. The muscle thus constrained bulges into the duodenum, forming a recognizable fornix, much as the cervix projects into the vagina. The peritoneal coat adheres closely to the muscular layer, especially at the duodenal end (Browne), but the muscle is easily separated from the submucous coat.

Appearance on section

On section the circular muscle is white and hard and cuts with a characteristic grating, and resembles an unripe pear. The cut surfaces tend to spring apart like a solid rubber tyre divided on a wheel.

Stomach and duodenum

The hypertrophy of the muscle shades off towards the stomach, which is always secondarily thickened; in some cases the oesophagus is similarly affected. There is no sharp line between the pyloric and gastric hypertrophy. Secondary gastritis is always present. On the duodenal side the thickening stops abruptly, and the duodenum is normal, the usual projection of the pylorus into the duodenum being accentuated; this is important surgically. The vessels of the pylorus are compressed, and the larger the tumour the more avascular it appears.

(4)—Clinical Picture

Vomiting

The infant begins to vomit after a feed. At first the vomiting is occasional and may occur only once in the twenty-four hours. Gradually it becomes more frequent and develops force, and more is vomited than has been taken in the last feed. The vomit is projected forcibly and may come down the nose as well as from the mouth. There is no bile in the vomit. With the onset of vomiting the method of feeding is usually changed; breast-fed babies are weaned, and artificially fed babies have their diet varied, producing sometimes a temporary improvement.

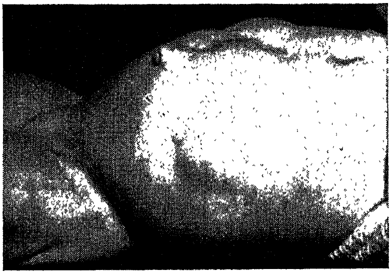

FIG. 29.—Photograph of infant with hypertrophic pyloric obstruction, showing visible gastric peristalsis

Wasting

Constipation

In some cases the vomiting is less prominent than the wasting, which is always noticeable. Constipation is almost constant: it was noted in 98 per cent of cases. Diarrhoea must be regarded as a rare but somewhat serious complication. Jaundice was found in 1·7 per cent of cases.

Jaundice

Pain and discomfort

The infant does not appear to suffer actual pain, but discomfort and hunger cause continual crying, and with the loss of weight a peculiar worried and drawn, almost elderly, expression marks the facies.

Gastric peristalsis

Inspection of the abdomen after a feed shows visible gastric peristalsis, and a wave or waves of contraction can be seen passing from left to right across the left hypochondrium and epigastrium (see Fig. 29). The appearance is that of a golf-ball rolling across the left upper abdomen. Sometimes the waves follow each other rapidly; at other times an occasional contraction only can be seen, and then with the exercise of much patience. Care must be taken not to mistake irregular contractions of the abdominal muscles, especially the recti, so often seen in any infant under examination, for a peristaltic wave. It is essential to give a feed of milk or water beforehand to elicit this important sign.

Palpation

Careful palpation of the abdomen with a warm hand discloses a pyloric tumour, and here again a preliminary feed is necessary to throw the pylorus into contraction, for unless the muscle is in spasm it cannot be felt. The examination is best conducted with the observer seated on the left of the patient, with his warmed hand pressing firmly but gently in the region of the upper and lateral part of the right rectus muscle, between the umbilicus and the right costal margin. The tumour lies rather deeply and is often best appreciated by rolling it against the spine; its recognition is much facilitated by practice. The right rectus muscle, the liver, or the right kidney may lead to error. The pyloric tumour should be felt in every case before an absolute diagnosis is made; it is a certain method of differentiating between simple pyloric spasm and congenital hypertrophic stenosis.

If it is possible to keep the infant alive by treating the spasm and the gastritis, the pyloric tumour may disappear in the course of a few months; progress is very slow, and the infant begins life gravely handicapped, but life is prolonged and may be preserved. The hypertrophied pylorus in time becomes normal. Thickening of the pyloric muscle, causing pyloric stenosis, has been found in the adult, but it is uncertain whether it is a persistence from infancy or a new development.

(5)—Course and Prognosis

The outlook depends on the weight of the child at birth and the degree of stenosis present. It is possible that a strong baby, suffering only from a slight hypertrophy of the pylorus, may recover without any specialized treatment. In most cases the disease is progressive and, untreated, leads to death from inanition. Not only is the infant starved, but the loss of fluids and chlorides by the repeated vomiting increases the depletion of the tissues and vascular system, alkalosis and ketosis usually following. Much can be done by administering fluids to take the place of those lost and by reducing the spasm which always accompanies the gastric stasis. This is the basis of all medical treatment and is also an essential part of surgical treatment.

Comparison of results of medical and surgical methods

Medical measures have been very unsuccessful in Great Britain and America. The mortality is about 80 per cent, and physicians in these countries are now convinced of the value of surgical intervention. The mortality of the simple surgical procedure is small, and figures show that the sooner operation is performed the lower the mortality.

Influence of infant's weight

Weight is an important factor in the prognosis. The lighter the child, the higher the mortality. If the weight is under 6 pounds at operation, the death-rate is 75 per cent. At 9 pounds the death-rate is nil.

Early operation as soon as the diagnosis is certain, before the weight has sunk far below normal and recuperative powers are lost, is clearly advisable.

(6)—Diagnosis and Differential Diagnosis

Difficulties in diagnosis

In a straightforward case, presenting the features of forcible vomiting, visible peristalsis, and palpable pyloric tumour, the diagnosis should not be difficult. Every feature, however, is not always present or recognizable. The vomiting may be only occasional and in very rare cases may be absent. When it does occur, so comparatively uncommon is the disease that doubt as to the suitability of the diet is raised and changes in feeding are made, with the patient continually losing ground. Peristalsis may not be visible in a case of hypertrophic stenosis, but, on the other hand, it may be visible in other conditions, e.g. pyloric spasm in a wasted infant. The tumour may be difficult to feel, and even the practised observer may have to wait patiently half an hour before the enlarged and spastic pylorus can be felt.

Nevertheless the onset of vomiting in the first few weeks of life in an infant otherwise healthy is at least suggestive and requires the consideration of hypertrophic stenosis of the pylorus as a possible cause.

Radiological diagnosis

An opaque meal followed by X-ray examination will give an absolute diagnosis, but as a general practice it is unnecessary and undesirable. The diagnosis can usually be made from careful consideration of the symptoms and signs: the technique of radiological examination puts some additional strain on an infant in no condition to sustain any further burden; this examination should therefore be reserved for the very few cases in which the diagnosis is much in doubt. The size of the stomach, the position of the pylorus, the one to two hour retention of the meal, and the active peristalsis are easily demonstrated.

Diagnosis from pyloric spasm

Pyloric spasm often simulates pyloric stenosis. Vomiting may occur after feeds, but it is not progressively forcible as it is in pyloric stenosis and is more amenable to alteration in diet and antispasmodic drugs. In a thin child peristalsis is often visible even with a mild degree of spasm. In simple spasm a pyloric tumour is never felt. It is a safe rule to insist on the recognition of the tumour before advising operation for pyloric stenosis.

From duodenal stenosis

Usually the obstruction of duodenal stenosis is at or below the papilla of Vater. Therefore in duodenal narrowing bile is present in the vomit, which is never the case in pyloric stenosis. No tumour is palpable. If the diagnosis is in doubt, much help can be given by radiology, a barium sulphate meal showing very clearly whether the obstruction is at the pylorus or in the duodenum.

(7)—Treatment

Choice of medical and surgical treatment

When the diagnosis has been made, treatment must be instituted at once, and in Great Britain and America the consensus of opinion is that the surgical measures offer certain relief. Before Rammstedt described the simple operation which goes by his name, medical treatment was the rule, and the mortality was as high as 80 per cent. From time to time dissatisfaction with these results encouraged surgical enterprise, but the procedures—gastro-jejunostomy, pyloroplasty—were too complicated and severe and never became established as routine methods of treatment. Scandinavian countries have always had greater success with medical measures. The essence of their treatment is feeding with thickened fluids, gastric lavage, and the administration of atropine. In 1935 Svensgaard reported three series of cases from Copenhagen treated on these lines with a mortality varying from 7·1 to 1·6 per cent. Her method has been tried at the Hospital for Sick Children, Great Ormond Street, but in most cases persistence of symptoms and progressive deterioration have necessitated surgical treatment.

Mortality of medical and surgical cases

During the period 1917–37, 1,061 cases have been admitted to the Hospital for Sick Children, Great Ormond Street. Three were admitted in a moribund state and died without treatment; 68 were treated medically with a mortality of 77 per cent, and the remainder were treated surgically with a mortality of 20·1 per cent. In the year 1937 the surgical mortality (92 cases) had fallen to 8·7 per cent.

Mortality in different types of institutions

Ladd has reported from Boston a consecutive series of 160 cases with no mortality. His patients are nursed in separate cubicles and have individual attention and very careful pre-operative preparation. The conditions approach more nearly those in private practice. In a private nursing home for children in London a consecutive series of 126 cases has been treated by operation without a death.

Pre-operative care and general nursing

The importance of preparation before operation and of segregation and individual attention after operation cannot be too earnestly emphasized. No case should be subjected to operation without preparation. Gastric lavage cleans the stomach and, by reducing its distension, facilitates the operation. Subcutaneous or intravenous infusion of 5 per cent glucose in physiological saline restores the body fluids lost by vomiting and reinforces the glycogen reserve. After the operation warmth, subcutaneous fluids, and protection from every possible source of infection, especially gastro-intestinal, are imperative.

Post-operative care

Technique of operation

Anaesthesia

Rammstedt's operation is now universally employed. The child is anaesthetized with gas and oxygen as the least toxic agent. Local anaesthesia can be employed, but experience shows that the mortality is higher with local anaesthesia than with gas and oxygen. The pylorus is delivered, and the peritoneal and muscular coats are divided in a line corresponding as nearly as possible to the lesser curve of the stomach. Along this line blood-vessels from the right gastric and gastro-epiploic arteries, which run transversely across the pylorus, fail to meet, and the tissue is comparatively avascular. The deeper part of the circular muscle is separated by blunt dissection, and the contracted mucous membrane expands freely into the gap. The incision must stop short at the 'zone of adhesion' (Browne) where the circular muscle fails to split, otherwise the duodenal fornix will be opened. On the gastric side the exposure of a fairly large and constant vessel will advise the operator that the necessary limit has been reached. Very rarely an arterial twig may

Limits of incision

require ligature. Save for the closure of the abdominal wall, this concludes the operation.

After-treatment

After the operation the infant is returned to his cot and kept warm. Subcutaneous infusion is generally advisable, and in a severe case intravenous administration of glucose solution or even blood transfusion may be necessary. Nothing is given by the mouth for four hours.

Feeding

Subsequent feeding depends on whether breast milk is available or not. For general guidance two schedules, for breast and bottle feeding respectively, are appended (see Tables I and II), but various modifications may be suggested by the practitioner. In most hospital cases it is possible and advantageous to discharge the child within or at the end of the week. Recovery is hastened by normal home surroundings. This early discharge is particularly desirable when the patient is being nursed in a large ward.

TABLE I.—Feeding of Breast-Fed Baby after Operation

4 hours after operation	5 per cent glucose solution, 1 fluid drachm hourly for 4 hours	
8 ,, ,, ,,	Breast milk and water in equal quantities – –	1 fluid drachm
9 ,, ,, ,,	Breast milk and water in equal quantities – –	2 fluid drachms
10 ,, ,, ,,	Breast milk and water in equal quantities – –	2 fluid drachms
12 ,, ,, ,,	Breast milk 2 parts and water 1 part – –	3 fluid drachms
16 ,, ,, ,,	Whole breast milk –	4 fluid drachms
18 ,, ,, ,,	,, ,, ,, – –	6 fluid drachms
24 ,, ,, ,,	Breast 3 minutes – –	1 fluid ounce
40 ,, ,, ,,	,, 10 ,,	
48 ,, ,, ,,	,, 20 ,,	

Subsequently breast-feeds of 20 minutes each are given 3-hourly.

TABLE II.—Feeding of Bottle-Fed Baby after Operation with a Reliable Skimmed Dried Milk

4 hours after operation	5 per cent glucose solution, 1 fluid drachm
8 ,, ,, ,,	1 fluid drachm of milk hourly
10 ,, ,, ,,	2 fluid drachms ,, ,,
12 ,, ,, ,,	4 ,, ,, ,, ,,
16 ,, ,, ,,	1 fluid ounce hourly
24 ,, ,, ,,	1 fluid ounce 2 fluid drachms hourly

Continue every 2½ hours for 12 hours.

36 hours after operation	1½ fluid ounces 3-hourly for 12 hours
48 ,, ,, ,,	2 fluid ounces 3-hourly

Increase to 2½ or 3 fluid ounces 3-hourly according to age.

Surgical accidents—wounds of the duodenum and stomach, haemorrhage, sepsis, or separation of the abdominal wound—should be rare. There have been only four instances of surgical accidents in the last 503 cases at the Hospital for Sick Children. *Complications* *Surgical accidents*

Diarrhoea and vomiting is the most fatal complication in hospital cases; it does not appear in private practice. It occurs most frequently on about the eighth day and is almost certainly due to infection from another patient. *Diarrhoea and vomiting*

To shock, alkalosis, and marasmus are accredited the majority of deaths occurring in the first forty-eight hours. Death is particularly likely to occur in infants much below the average weight at operation, i.e. below 7 pounds. *Shock, alkalosis, and marasmus*

In the early days of the operation a temperature of 105° or 106° F. was not uncommon, but in recent years it has never occurred. Its cause is in doubt. Its ill-effects are lessened by cold sponging. *Hyperpyrexia*

2.–PYLORIC SPASM

1335.] A condition has been described in infants characterized by vomiting and attributed to spasm of the pylorus. It differs from the much commoner hypertrophic stenosis in the following particulars: (i) it occurs in older children, and may begin at the twelfth week, at a time when the onset of hypertrophic stenosis is very rare; it is commoner in the artificially fed; (ii) the vomiting, which may be forcible, is less regular in its occurrence; several days may pass without this symptom; (iii) peristalsis may be visible, but is not so striking a feature; (iv) X-ray examination shows delay at first, but gradually the pylorus relaxes and the meal is passed; (v) it is readily amenable to treatment; correct diet, antispasmodics, and, in severe cases, lavage bring about a cure; and (vi) it is rarely fatal. *Diagnosis from hypertrophic stenosis*

Most cases of pyloric stenosis are first regarded as pylorospasm. Indeed, in the first onset there is little to distinguish the two conditions. It is only the inefficacy of treatment, the persistence and aggravation of symptoms, and the palpation of a pyloric tumour that lead to the diagnosis of the more serious malady.

If breast milk cannot be obtained, thickened feeds in small quantities should be given. Belladonna or atropine may be given by the mouth. Regular lavage of the stomach twice daily is of the greatest benefit. *Treatment*

3.–PYLORIC OBSTRUCTION IN LATER LIFE

(1)—Causes

1336.] Obstruction of the pylorus in later life may be due to intrinsic or extrinsic causes. The intrinsic are more usual and include simple tumours, cicatricial contraction, and peptic ulcer. Malignant tumours *Intrinsic* of the pylorus are discussed in the article STOMACH DISEASES. Obstruction arising extrinsically may be due to the pressure of tumours in the neighbourhood, to peritoneal adhesions, or to gross alterations in the anatomical position of the stomach.

Extrinsic

(*a*) *Intrinsic*

Simple tumours

Adenoma, fibroma, and myoma are rare, but adenoma is the least rare. If a simple tumour arises within the pyloric area it will gradually obstruct the pylorus (see Fig. 30). Sometimes it originates in the pre-pyloric region and, as a result of peristaltic action, becomes pedunculated and produces an intermittent 'ball-valve' action on the pyloric outlet.

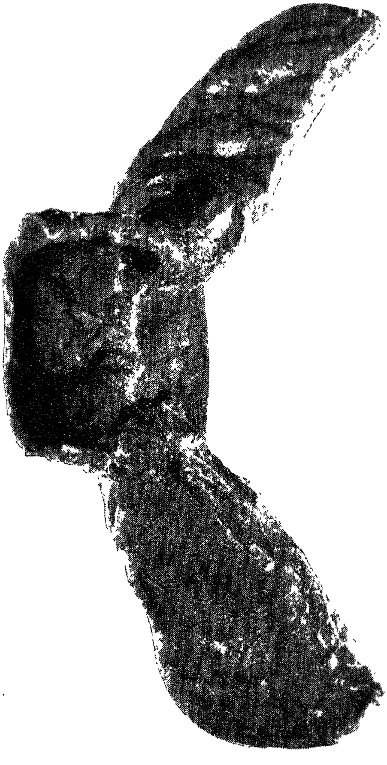

FIG. 30.—Adenoma of pylorus treated by pylorectomy

Cicatrization

Cicatrization is probably the commonest cause of simple pyloric obstruction. When an ulcer situated at the pylorus heals, the pyloric ring becomes scarred, and fibrous constriction may reduce the lumen. Cicatrization is generally associated with a long history of dyspepsia, with many periods of apparent cure followed by relapse. The ulceration may be multiple. A single ulcer, healing within a reasonable time, is not likely to produce sufficient scar tissue to cause obstruction.

Active peptic ulcer

An active peptic ulcer at the pylorus may cause obstruction reflexly by spasm or mechanically by local reaction and oedema.

(*b*) *Extrinsic*

Tumours

Extragastric tumours sometimes occlude the pylorus by pressure from without. A greatly distended gall-bladder or a tumour of the liver, kidney, or pancreas may distort the pyloric outlet and interfere with gastric evacuation, but actual obstruction is rare.

Peritoneal adhesions sometimes impede the normal functions of the pylorus. An inflamed gall-bladder may be responsible, but more often gross adhesions following a previous perforation of a gastric or duodenal ulcer constrict the pylorus or hold it in some abnormal position.

Peritoneal adhesions

In visceroptosis the stomach may droop to a low position in the abdomen, but, by virtue of its normal supports and the fibrous bands which develop secondarily in response to the strain, the pylorus is held at its normal level. A vicious circle is established, and the lower the organ falls the more acute is the kinking at its outlet. The obstruction is more often functional than organic, but sometimes true obstruction occurs as is shown clinically and radiologically by vigorous peristalsis with delayed evacuation.

Visceroptosis

(2)—Morbid Anatomy

In chronic pyloric obstruction the stomach is hypertrophied and dilated. The changes may extend to the oesophagus. The stomach sometimes reaches a very large size, with the greater curvature at the pelvic brim. The largest stomachs are found in simple obstruction, for with malignant obstruction it is probable that the diagnosis will be made sooner, or that the disease, if undiagnosed, will prove fatal before any considerable hypertrophy and dilatation have occurred.

Size of stomach

The pyloric changes depend on the cause. If the scar of a healed ulcer is present, especially if it is of long standing or multiple, the walls of the pylorus are converted into scar tissue. The lumen may only admit a quill, or it may be completely stenosed. If an active ulcer is present, each coat is oedematous, and the resulting swelling occludes the opening. The swelling of all the parts may be sufficient to form a palpable tumour. Dense adhesions, the result of acute inflammation of the gall-bladder or the previous perforation of a duodenal or gastric ulcer, cause obstruction usually by holding the pylorus fixed in an abnormal position, e.g. by adhesion to the liver, rather than by direct pressure of the adhesions.

Changes in pylorus

(3)—Clinical Picture

The patient may be of any age or either sex. The first symptoms are discomfort and a feeling of fullness in the upper abdomen after meals. Pain is rare in the early stages, unless peptic ulcer is present also: in the later stages strong peristaltic waves may cause painful cramp-like contractions.

Pain and discomfort

Nausea is common; vomiting soon follows and is characteristic. It occurs usually at the end of the day but is of very variable onset. Sometimes a day or two elapse between vomits, but later the patient finds relief by vomiting and adopts artificial means of emptying the stomach at will. The vomit is sour and contains the altered food of a previous meal or meals. The odour is foul, and the breath becomes malodorous.

Nausea and vomiting

Loss of appetite and constipation occur; wasting is progressive and may become extreme.

General symptoms

Physical signs

On inspection the upper abdomen is fuller than the lower, and waves of gastric peristalsis may be seen passing from left to right across the epigastrium. Splashing is readily detected on palpation. No tumour can be felt except in those rare instances in which an inflammatory mass forms around a simple ulcer.

Analysis of stomach contents

Analysis of the stomach contents withdrawn by tube assists in the diagnosis, but the findings are not constant. Usually there is an absence of free hydrochloric acid with an increase of total acidity; but in the presence of an active ulcer the free hydrochloric acid may be increased. Fungi and Boas-Oppler bacilli are usually present also.

(4)—Course and Prognosis

Unrelieved the patient will die of inanition or from some intercurrent infection due to lowered vitality. In pyloric obstruction surgery offers immediate and striking relief. The successful performance of a short-circuiting operation, when the pylorus is obstructed by a simple cause, is often dramatic in its effects. It is here that gastro-enterostomy finds its most useful and certain field. Of the types of obstruction, fibrous contraction of the pyloric outlet is the most favourable. A simple posterior gastro-jejunostomy drains the stomach and is not likely to be followed by the occasional unhappy sequelae, such as anastomotic ulcers, regurgitant vomiting, or a continuation of the dyspepsia, which may follow gastro-jejunostomy performed for non-obstructive conditions. If the obstruction is due to a simple tumour, a more complicated procedure—pylorectomy—is necessary, and the outlook is to this extent somewhat more serious.

(5)—Diagnosis

Diagnosis of condition

The diagnosis of pyloric obstruction is, as a rule, straightforward: the cause of the obstruction is less easy to determine. If a patient begins to suffer from discomfort after meals, which is followed and relieved by vomiting, is not much aided by diet, except semi-starvation, and is accompanied by anorexia, constipation, and wasting, pyloric obstruction may be suspected. If the physical signs—distension of the stomach and visible peristalsis—are present, the diagnosis is obvious. A barium sulphate meal and X-ray examination will give confirmatory evidence (see Plate I).

Diagnosis of cause

It is more difficult to be certain of the cause. The history helps; symptoms of long-standing ulceration at least suggest cicatricial contraction. A malignant tumour sufficiently developed to cause obstruction is recognizable on palpation and can be demonstrated radiographically. Gastric analysis can sometimes confuse. Excessive free hydrochloric acid suggests an active ulcer and absence of hydrochloric acid a new growth, but several variations are found, and the evidence is not always helpful. Determination of the underlying cause cannot be made with certainty without operation; but, since the prospect of

Radiograph of stomach of patient with cicatricial stenosis of pylorus: barium sulphate swallow

PLATE I

[*To face p.* 436

relief in pyloric obstruction, whatever the cause, depends on operation alone, there should be no delay in adopting surgical measures.

(6)—Treatment

Medical

The fault is mechanical and can only be corrected by mechanical means. Medicine cannot cure pyloric stenosis, but it can relieve the patient of some distressing symptoms and make the operation safer. The diet must be cut down to nutritive fluids or easily digested semi-solids, depending on the degree of obstruction. Gastric lavage, performed daily, relieves the patient of much discomfort and simplifies the operative procedure. The stomach becomes reduced in size and less distended with gas, and the fermentative organisms are inhibited.

Surgical

Posterior gastro-jejunostomy is the most satisfactory method of short-circuiting the obstruction. Gastro-duodenostomy and pyloroplasty may be preferred on theoretical grounds in that they disturb the normal anatomical arrangement less, but they are sometimes impracticable and always more difficult technically than a gastro-jejunostomy.

Choice of operation

If the obstruction is due to a cicatricial contraction, posterior gastro-jejunostomy is a relatively simple operation and most satisfactory in its results. If the obstruction is due to a simple tumour, a partial gastrectomy according to the Billroth 1, or, perhaps better, the Polya technique is necessary. Local excision of the tumour after opening the stomach is rarely possible. If a chronic but active ulcer of the pylorus is responsible for the obstruction, gastro-jejunostomy is often followed by complete relief of symptoms and eventual healing of the ulcer. Some authorities believe that a partial gastrectomy is better. If hyperchlorhydria is present, a partial gastrectomy is less likely to be followed by an anastomotic ulcer.

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PYOMYOSITIS, TROPICAL

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1.–DEFINITION

(*Synonyms.*—Myositis, myositis purulenta tropica)

1337.] This is a pyaemia, characterized by low-grade suppuration in the muscles, occurring most commonly in natives in tropical countries and less frequently in Europeans.

2.–AETIOLOGY

The frequency of deep-seated intramuscular abscesses in native races has for some years attracted the attention of tropical practitioners. It was formerly thought that they were in some manner connected with *Wüchereria* (*Filaria*) *bancrofti* infections; but myositis occurs as an independent condition and is common in countries where filarial infection does not exist.

Two main forms of tropical myositis exist, one consisting of hard indurated painful swellings, situated deep in the muscular tissue, which are brought about by the collection of serous fluid, and the other associated with extensive suppuration. The organism responsible is, it is generally admitted, *Staphylococcus pyogenes aureus* and occasionally, in my experience, *Streptococcus pyogenes.*

These intramuscular abscesses are found in the popliteal space, adductor muscles of the thighs, serratus magnus, and latissimus dorsi muscles.

The following types of myositis are thus distinguished: (i) acute non-suppurative; (ii) acute suppurative; (iii) acute suppurative with relapses; (iv) acute suppurative with pyaemia; and (v) hyperacute, ending in septicaemia. Pyomyositis most usually occurs in persons who are debilitated as the result of some other long-standing infection, e.g. ankylostomiasis, malaria, and syphilis. In my series of cases the Wassermann reaction has been positive in 50 per cent. Treatment should be directed towards the eradication of the fundamental infections.

3.–DIAGNOSIS AND DIFFERENTIAL DIAGNOSIS

The diagnosis of pyomyositis should not present any difficulties; but it may have to be distinguished from gummata, filarial abscesses, glanders, melioidosis, and rheumatic nodules. Deep-seated intramuscular abscesses are more liable to arise in persons who are debilitated by malaria or some other chronic infection. The swellings are hard, red, and tender, and are usually associated with superficial oedema.

4.–TREATMENT

The various abscesses should be evacuated, and prophylactic measures should be established against the occurrence of others in other situations. The non-suppurative lesions should be treated by continuous fomentations, together with vaccine treatment, using a culture of the organism concerned. Treatment by radiant heat is also useful. If there is a history of syphilis, local measures should be combined with bismuth and neoarsphenamine injections.

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PYOSALPINX

See FALLOPIAN TUBES DISEASES, Vol. V, p. 252

PYREXIA OF OBSCURE ORIGIN

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Reference may also be made to the following titles:

ENTERIC FEVERS
PSITTACOSIS
SEPTICAEMIA AND BACTERIAEMIA
SYPHILIS
TUBERCULOSIS

1.–DEFINITION

1338.] The term pyrexia of obscure origin indicates the clinical condition in which fever is apparently the sole manifestation. In many cases the patient recovers without any diagnosis having been made, often after weeks, months, or even years of fever; some patients develop signs or symptoms which give a clue to the diagnosis; and in others the cause is demonstrated only at operation or at necropsy.

2.–AETIOLOGY AND DIAGNOSIS

The usually accepted normal temperature of 98·4° F. (37° C.) is subject to individual variations; some persons with temperatures differing appreciably from this are nevertheless not ill, though some of them may show evidence of a neurosis which may possibly cause the fever or be the result of the investigations undertaken in an effort at diagnosis. The cases have been divided into two groups: (i) low-grade fever rarely higher than 100° F. in usually ambulant subjects, and (ii) higher fever, the patients being usually confined to bed (Hamman and Wainwright). Reimann, who described cases in group (i) lasting for years without obvious evidence of disease, loss of weight, or positive results of elaborate diagnostic tests, suggested that the normal limits of tempera-

Habitual hyperthermia

ture range should be 97° F. to 100° F., and that there must be many instances of 'habitual hyperthermia' unrecognized because not investigated.

Enteric fever

In patients with considerable fever and obviously ill the aetiological problem of the organic cause often arises. One of the enteric fevers should be considered first; many patients pass through enteric fever without diarrhoea or rose spots or are in other ways atypical. In children especially, cerebral symptoms may predominate, suggesting meningitis, and the pulse tends to be rapid rather than slow (see Vol. V, p. 63).

Tuberculosis

Chronic miliary tuberculosis

Epi-tuberculosis

Tuberculous meningitis

Tuberculosis, especially the acute generalized miliary form, may for some time be diagnosed only as fever, often irregular and inverse, the temperature being higher in the morning than in the evening. Sweating, cyanosis, tachypnoea, and the presence of tubercles in the choroid and, as shown by radiography, in the lungs will help in the diagnosis. Miliary tuberculosis may also be chronic, producing prolonged fever with recovery, or death only after many years (Sayé). The occurrence of epituberculosis in the course of pulmonary tuberculosis may be shown by fever unexplained by ordinary physical signs in the lung. Radiologically there is an opacity involving a wedge-shaped area of lung resembling a collapsed lobe, usually with a well defined lower edge. This is thought to be an inflammatory reaction round the site of primary infection (Ghon's focus). The course is generally prolonged, with fever lasting for weeks or months, few or no physical signs, and eventual recovery after treatment on sanatorium lines, though some cases develop active progressive disease. Tuberculous meningitis may be present without obvious physical signs other than pyrexia, particularly in children, for as long as three weeks, the patient being lethargic, drowsy, silent, and constipated. No clue to the diagnosis may be found until a slight stiffness of the neck, photophobia, or sudden delirium suggests the performance of lumbar puncture, which reveals the disease.

Endocarditis lenta

Endocarditis lenta (subacute bacterial endocarditis) presents irregular fever with perhaps intervals of apyrexia, lasting for many months, up to two and a half years. There may be evidence of previous valvular disease or congenital heart defects, and the murmur, usually systolic, changes in character from time to time. The characteristic signs of the disease, especially embolic phenomena, such as aphasia, retinal haemorrhage, and hemiplegia, haematuria, albuminuria, and petechiae, may appear late, but even a few petechiae about the neck and shoulders will help to decide a doubtful case. *Streptococcus viridans* may be found on blood culture, and Osler's nodes on the fingers are pathognomonic. (See HEART DISEASES: ENDOCARDITIS, MALIGNANT, Vol. VI, p. 301.)

Glandular fever

Glandular fever of the febrile type common in adults, when the rash is not evident, is of short duration and should be identified by the presence of a mononucleosis and of heterophil antibodies in the serum (see GLANDULAR FEVER, Vol. V, p. 572).

Hodgkin's disease

Other febrile conditions in which the clinical picture may not be obvious at first include Hodgkin's disease in which the deep-seated, such as the retroperitoneal, glands only are enlarged (see HODGKIN'S DISEASE, Vol. VI, p. 531); acute leukaemia in the early stages before the blood picture has been found to be typical; and some diseases of the liver, such as syphilis, malignant disease, and cirrhosis. In alcoholic hepatitis fever, furred tongue, slight jaundice, tenderness over the liver, and a laevulose test showing impairment of hepatic function will occur after over-indulgence in spirits and may persist for some weeks. Tertiary syphilis of the liver is probably commoner than is recognized and may cause a continued fever with one or more of the following: epigastric discomfort; ascites; enlargement of the liver, sometimes very large and irregular from the presence of gummata and scars, and frequently affecting the left rather than the right lobe (McCrae and Caven); and, rarely, jaundice. If the history or the presence of syphilitic lesions elsewhere suggests the diagnosis, treatment by potassium iodide and mercury may be dramatically followed by disappearance of the fever and other signs of the disease; but arsenical preparations are contra-indicated. The blood Wassermann reaction may be negative, and no weight should be attached to this finding if other considerations make syphilis a possible diagnosis. It may be positive in the ascitic fluid.

Acute leukaemia

Hepatic disease

Amoebic hepatitis

Some cases of amoebic hepatitis appear as fever of doubtful origin, and the liver may not be obviously large or tender. The diagnosis may not be made unless dysentery is suggested. Dysentery is not an exclusively tropical disease but occurs also in temperate climates though often regarded as 'colitis'.

Focal infection

Focal infection may, on careful search, be discovered as the cause of an otherwise puzzling fever, e.g. dental sepsis, tonsillar sepsis, nasal sinusitis, and, in children, pyelitis and otitis media. Persistent fever has occasionally subsided after elimination of dental sepsis. The importance of 'hidden foci of infection', such as oral sepsis, in the causation of obscure fever has recently been seriously challenged (Kintner and Rowntree; Hamman and Wainwright). But a patient with pernicious anaemia and an intermittent fever reaching 101° F. in the evenings completely failed to react to liver extract therapy; whereas cessation of the fever with immediate haemopoiesis followed extraction of six teeth showing a not very spectacular pyorrhoea. Jents reported thirteen cases of pyrexia of unknown origin in which cure resulted from removal of infected tonsils. Sohval and Som investigated nine patients in whom fever, which had lasted for periods as long as two and a half years, was explained by nasal sinusitis and cured by lavage of the antra and by antrostomy. They pointed out that the patients had neither clinical evidence nor intranasal signs of the sinus affection, which was discovered on transillumination and radiography of the sinuses and by the isolation of staphylococcus and *Streptococcus viridans* from the lavage fluid.

Dental sepsis

Tonsillar sepsis

Nasal sinusitis

Children, especially those of nervous temperament and heredity, are particularly liable to develop fever from causes insufficient to produce it in adults. It may take the form of recurrent attacks lasting a few hours or days or be prolonged at a comparatively low level for months or years. Some of these latter are probably instances of 'habitual hyperthermia' (see p. 441), but others are pathological, since they may return to normal levels in time. Before deciding that a case is one of unexplained pyrexia the following conditions must be excluded: (i) nasopharyngeal sepsis, septic tonsils and adenoids, and otitis media; acute otitis media and mastoiditis may be present without pain and even without visible changes in the tympanic membrane, so that the diagnosis may not occur to the examiner's mind until a purulent ear-discharge or acute cerebral symptoms appear; chronic middle-ear catarrh may be responsible for a low-grade pyrexia lasting for weeks or months; (ii) acute pyelitis, which is often seen in female infants and may, without causing local symptoms and signs, give rise to considerable constitutional upset, high temperature, pallor or blueness, restlessness, and an anxious facies; pus will be found in the urine collected in the folds of a rubber sheet or in a Spicer urinal; (iii) pneumonia, especially apical or central, which may not present any definite signs for some days but may be inferred from the tachypnoea and the grunting inverted respiratory rhythm; (iv) dentition fever, the development of a fever, often high, for a few days before the eruption of each tooth; and (v) alimentary disturbances, including those due to intestinal worms, the presence of which may be associated with fever, often high, and drowsiness or screaming, suggesting grave cerebral disease; constipation; excessive feeding, particularly with carbohydrate foods, in which case the child may pass pale stools with much mucus; and to the so-called bilious attacks, in which the fever is often high and accompanied by ketosis.

Fever in children

Otitis media and mastoiditis

Acute pyelitis

Pneumonia

Dentition fever

Alimentary disturbances

Tropical diseases must be thought of in persons returned from endemic areas. Malaria may apparently relapse spontaneously, or an attack may be precipitated by intercurrent illness; but after a year's absence from a malarial zone a true malarial relapse is unlikely in the absence of reinfection. The discovery of parasites in the blood film should settle the diagnosis. Trypanosomiasis (Central Africa), kala-azar (India, China, Mediterranean, and Sudan), and relapsing fever are possible causes of fever after return from the respective countries, and tularaemia causes a fever lasting from three to six weeks, with glandular enlargement. Dengue (seven-day fever), phlebotomus or sand-fly fever (three-day fever), and undulant fever must also be mentioned. The last may have a continuous fever, without the undulations which give it its name. Finally there is the closely related abortus fever, which is commoner in Great Britain than is at present realized (see Vol. I, p. 70).

Tropical diseases

Deep pus may be suggested by hectic fever and a polymorphonuclear leucocytosis, and its location by such measures as radiography for an interlobar empyema, or by pain and swelling in the loin in the case of a perinephric abscess. The difficulty in diagnosis of deep suppuration is exemplified by an instance in which an abscess had resulted from

Deep pus

intramuscular injection of alum toxoid for diphtheria immunization. Local symptoms and signs were absent for two weeks, and then the diagnosis was settled only on mensuration by which a slight increase in circumference was discovered, and by an exploratory needle.

Syphilitic aortitis

Bact. coli septicaemia

Many other conditions may produce fever out of proportion to other symptoms and signs, but their inclusion in this article would be a mere catalogue and serve no useful purpose. Each such case should be dealt with on its merits and painstaking search made for the cause of the fever, with the clear understanding that considerable delay may occur in its ultimate elucidation. Thus, fever may occur in the secondary and tertiary stages of syphilis and has been recorded even in syphilitic aortitis (Laszló); in the latter event difficulty might arise in the diagnosis from endocarditis lenta. The fever may be of comparatively little importance, as in *Bact. coli* septicaemia, which is usually a terminal event and present only for a day or two before death. In the rare instances in which it is not a terminal event it is generally associated with local infection of the urinary tract.

Nervous and mental disease

Hysteria and malingering

Fever may also accompany nervous and mental diseases, such as hysteria, manic-depressive psychosis, delirium tremens, and neurocirculatory asthenia, and the possibility of malingering should also be kept in mind, as well as the occurrence of climatic fever in susceptible individuals when the weather is hot and humid. In this group the fever is usually of short duration, though it may be high, temperatures of 104° F. having been recorded in hysteria and malingering. In such cases the contradictions in the clinical picture should suggest the diagnosis.

Many patients with fever recover or die undiagnosed. Kintner and Rowntree analysed 100 cases of long-continued low-grade idiopathic fever lasting from one month to thirteen years in which diagnosis was made either never or only at necropsy. In the few fatal cases death was due to malignant disease, bacterial endocarditis, and streptococcal infection.

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PYURIA

See BLADDER DISEASES, Vol. II, p. 397; KIDNEY, SURGICAL DISEASES, Vol. VII, p. 400; *and* PYELITIS, p. 404

QUINCKE'S DISEASE

See ALLERGY, Vol. I, p. 322

QUINSY

See TONSILS DISEASES

RABIES

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Reference may also be made to the following title:

LANDRY'S PARALYSIS

1.–DEFINITION

(*Synonym.*—Hydrophobia)

1339.] Rabies is an infective disease characterized by a long incubation period followed by a short period during which symptoms are evident. The disease exists naturally as an enzootic chiefly among members of the canine tribe, but infection may be transferred from these, by the act of biting, to the majority of warm-blooded animals. The symptoms are nervous, either excitation or depression. Once symptoms have developed, a fatal issue must be expected.

2.–BACTERIOLOGY, PATHOGENESIS, AND PATHOLOGY

Causal virus

The causal agent of rabies belongs to the group of neurotropic filterable viruses. It grows in the animal body only within nerve elements, is ultra-microscopic and diffusible, and, when separated from gross nerve substance, cannot be isolated by centrifugalization. It passes through Chamberland L2 and L3 filters and celloidin sacs. It can be cultivated *in vitro* in a medium composed of Tyrode's solution containing fragments of embryonic rabbit or mouse brain (Kanazawa; Webster and Clow).

Virulence

Its activities are destroyed by antiseptics, such as formaldehyde solution, phenol, ether, and yatren, by most ferments, and by such physical agencies as heat, slow desiccation, ultra-violet rays, and the photodynamic action of various dye-stuffs. On the other hand, its virulence persists for considerable periods in the frozen state, when rapidly dried to a powder, and in 30 per cent glycerin. The virus or the substance upon which it is adsorbed carries a negative charge. The sera of animals inoculated with the virus may contain antibodies, but their specificity for the virus remains in doubt.

Infection

For a successful infection the virus must be implanted upon nervous tissue. Thus infection is impossible without some trauma of epidermis or of mucosa.

Dissemination

After implantation the virus, either by diffusion or by multiplication, is disseminated along the nerve-trunks, whether within the axis-cylinders or in the perineural lymph-spaces has not been definitely ascertained. Dissemination is both centrifugal and centripetal. When the virus has reached by way of the nerve the related segment of the spinal cord, its further course is either upwards or downwards along the cord or centrifugally down the efferent nerves. The rate of dissemination along nerves is slow; consequently the length of the incubation period of the disease is directly related to the distance to be travelled from the site of implantation to the vital centres. Thus for bites on the leg the average period of incubation is about 60 days, for bites on the arm it is about 40 days, and for bites on the head it is about 30 days.

Incubation

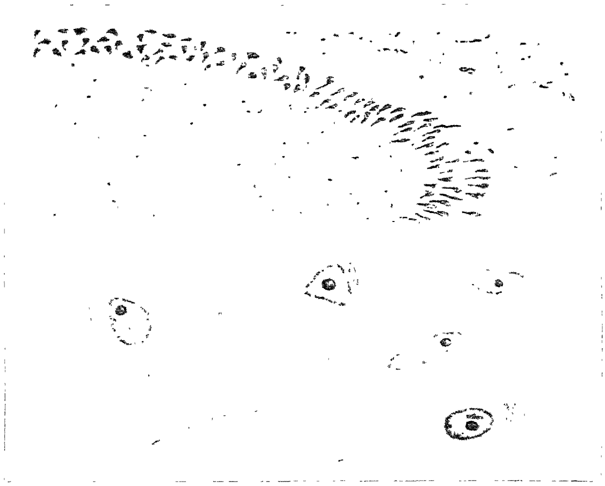
Efferent nerves

By dissemination down efferent nerves the virus is conveyed to the nerve terminals and nerve ganglia of the various organs. These become infective in proportion to the number of neurones which they contain. When the organs are secretory, their secretions, if ganglion cells are shed into them, may be infective (Manouélian and Viala). The infectivity of saliva was demonstrated in 1804 by Zinke.

Brain

As the virus passes upwards, the higher centres are successively involved, and the brain becomes infective, though not uniformly so. The infectivity of the brain tissue was first demonstrated by Pasteur in 1881, and this observation led to the important developments associated with his name. A new and experimental mode of infection had been discovered, *Sub-passage* and he found that by sub-passage from the brain of an infected rabbit to the brain of an uninfected rabbit the properties of the virus became altered. The virus could be sub-passaged indefinitely, but during the course of sub-passage the incubation periods in the successive rabbits became shorter, until a constant incubation of about six days was *'Fixed virus'* attained. This virus of constant incubation was a standard virus and is called 'fixed virus'; the virus as it exists in nature, the incubation period *'Street virus'* of which is very variable, is designated 'street virus'. It has since been shown that street virus can be fixed by sub-passage through the brains of numerous other species, e.g. sheep, dog, guinea-pig, and monkey; still more recently Nicolau and Kopciowska showed that the process of fixation is reversible, and that by sub-passage from the sciatic nerve of one animal to the sciatic nerve of another the fixed virus can be retransformed into the street variety. It would appear then that by continued cultivation on a substratum of brain substance the virus is placed under conditions which favour its growth; in these conditions the struggle for existence is minimal, and the virus becomes more luxuriant though less hardy. On the other hand, when passaged from nerve to nerve under conditions approximating more closely to those which occur in nature the struggle for existence is greater and the virus becomes more hardy though less luxuriant. The differences between the two types of virus are thus more quantitative than qualitative. Fixed virus multiplies and so becomes disseminated in the central nervous system more rapidly than does street virus, but it is very much less infective when introduced subcutaneously. Fixed virus causes symptoms of paralysis and only rarely those of excitability (fury) in the infected animal, whereas the reverse occurs with street virus. The histological changes in the brain, which are those of an encephalomyelitis, are less severe in fixed virus rabies than in that due to street virus. Fixed virus then in addition to being a standard virus is also attenuated, and in both these respects it is suitable for immunization. The forms in which it has been administered as a vaccine are many, but, as might be expected, their general effects, when suitable doses are used, do not differ significantly.

Negri bodies The precise nature of the virus of rabies has been the subject of much speculation. The microscopical evidence of its presence is the inclusion body called after its discoverer, Negri (1903). This is an oxyphil structure found in the cytoplasm of the neurones and their processes (see Plate II). Negri bodies vary in size from 1 to 30μ. Generally speaking, the slower the progress of the disease the larger the Negri body. Very large bodies are often found in horses and cattle. In the larger bodies an internal structure is usually apparent, the body resembling a mass of spores embedded in a hyaline matrix. This appearance, suggesting sporulation, has led various workers, including Negri, to the conclusion that the



Negri bodies in rabies, stained by Mann's method. Above: layer of large pyramidal cells in hippocampus major (× 70). Below: isolated pyramidal cells, containing Negri bodies which show inner structure (× 600)

PLATE II

[*To face p.* 448

organism is protozoal, and that the Negri body is one stage in its life-cycle, the ultra-microscopic virus being another stage. For these reasons the names *Neuroryctes hydrophobiae* (Calkins), *Glugea lyssae* (Levaditi and Schoen), and *Encephalitozoon rabiei* (Manouélian and Viala) have been applied, and the stages of a life-cycle have been variously described. Other workers, on the contrary, hold the view that the Negri body is the visible evidence of a reaction of the nerve cell against the virus, and still others consider it to be of nuclear origin. All that can be said is that it is an inclusion body, specific for rabies, of the same type as in many other diseases caused by filterable viruses. Negri bodies may be found in any of the neurones of the nervous system. They are usually searched for in the pyramidal cells of the hippocampus major (cornu Ammonis), but it has been shown (Thomas and Jackson) that the site of election in the rabbit at least is the oculomotor nucleus. In fixed virus rabies they are practically never present in the former position but may be found in the latter. The presence of Negri bodies is one of the main elements in the post-mortem diagnosis of rabies, and their presence in neurones other than those of the oculomotor nucleus may be taken as almost certain evidence that the virus is of the street variety.

Epidemiology

The continuance of rabies in nature depends almost entirely on the canine enzootic, and its occurrence in man and other animals is in almost every instance a secondary manifestation. Rabies has been reported as occurring in practically all warm-blooded animal species. Cold-blooded animals, such as the toad, the frog, and the tortoise, are refractory to the disease, although the virus may survive in their brains over long periods. It has been shown that the vampire bat (*Desmodus rotundus*) transmits the cattle epizootics of Brazil (Haupt and Rehang), and that another species of vampire bat is the vector in the curious epidemics of paralytic rabies which occur in Trinidad (Pawan). Genets and meerkats are mainly responsible for the rabies of South Africa. Herbivora and Equidae, though subject to the disease, can seldom if ever transmit infection.

3.–CLINICAL PICTURE

Symptoms

There are two main clinical types of rabies: in the first, which in man is much the more usual, the symptoms are those of hyperexcitability (spasm); in the second, a very much rarer type, symptoms of depressed activity (paralysis) predominate.

Onset

The incubation period was discussed on page 447. The onset of the disease is as a rule sudden. In some cases there is a prodromal stage, lasting 2 to 3 days, characterized by a general malaise. During this period there may be a slight fever, and the patient may complain of headache and insomnia, and of pain at the site of the bite. General uneasiness and restlessness may manifest themselves, and the patient becomes a prey to anxiety. This is soon followed by symptoms of hyperexcitability.

Breathing becomes more rapid, often amounting to 'air hunger', with deep sighing respirations, and this may be accompanied by precordial distress. So long as the attention is fixed, speech is normal; then, momentarily, anxiety expresses itself, and speech comes in rushes; the patient recovers with a sigh, and a period of calm follows. The attacks become progressively more frequent and intense and soon take the form of spasm. The larynx and pharynx are progressively involved, and swallowing becomes difficult. If a glass of water is offered, as it approaches the lips the head recedes in spasmodic jerks, respiration comes in gasps, the gaze is fixed, hands clutch what they can reach, and the fluid, if it reaches the mouth, is spluttered out. In the later stages the thought of drinking is sufficient to induce spasm, and other stimuli, such as a slight movement, a sudden sound, and even a draught of air, have a like effect. Salivation is increased. A thick ropy mucus collects in the mouth and is scattered over the room. During the intervals as before there is complete calm, the mind is clear, and speech is natural. This dramatic alternation from nerve storm to normality is unforgettable. Later the spasms become generalized, the body becomes rigid and arched, and the breath is held. Death occurs usually during a spasm and often at an unexpectedly early stage. Tendon-reflexes are exaggerated, and the temperature may be raised. In the rare cases which survive the spasmodic stage a calmer period, during which the symptoms are those of paresis, is said to precede the ultimate fatal issue. The duration of the illness is usually from three to four days.

Paralytic type

In the epidemic in Trinidad (see p. 449) the clinical picture was different and simulated that of 'an acute ascending transverse myelitis'. The symptoms were those of paresis of the limbs, bowels, and bladder, with loss of sensation in the limbs and abdomen. Respiration and deglutition became affected only in the later stages. The paresis was of an ascending type, and the average duration was about eight days.

4.–COURSE AND PROGNOSIS

Although, when symptoms have appeared, the disease is invariably fatal, there is evidence that infection by the virus may be arrested either from natural causes or by Pasteurian treatment.

Mortality among untreated patients

The mortality among the untreated cannot be defined, because the degree of risk to which they may have been subjected is variable and unknown.

Among treated patients

It appears, however, from statistics of the treated that a deep bite is about five times as dangerous as a superficial bite, and that intervention of clothing reduces the mortality in the ratio of 8 to 1. The mortality rate is also influenced by the position of the bite, the relative ratios for those bitten on the head, arm, and leg being 15, 2, and 1 respectively.

5.–DIAGNOSIS AND DIFFERENTIAL DIAGNOSIS

(1)—Clinical

As a rule there is little difficulty in diagnosing the disease. The history of a bite by a rabid animal, the period of incubation, the characteristic clinical picture, and the rapid course of the illness leave little doubt.

Differential diagnosis

Confusion is possible with hysteria, tetanus, atropine poisoning, and Landry's paralysis.

From hysteria

Hysterical symptoms may follow a bite, but they are usually mistimed and occur too early for a diagnosis of rabies to be possible.

From tetanus

In certain cases of tetanus in which the muscles of the throat and neck are involved diagnosis may be difficult, but the rather shorter incubation, 6 to 14 days, the presence of tonic spasms of the facial muscles, trismus, and opisthotonos are usually sufficient to distinguish tetanus from rabies.

From atropine poisoning

Cases of atropine poisoning in which excitability is marked may also simulate rabies, but the wide reactionless pupils and the dryness of mouth and throat are not seen in rabies.

Diagnosis of paralytic rabies

The diagnosis of the extremely rare, though reported, cases of paralytic rabies which simulate Landry's ascending paralysis must rest upon the case history and ultimate post-mortem evidence.

(2)—Post-Mortem

The post-mortem diagnosis of rabies depends on the demonstration of Negri bodies in the brain and the proof of the presence of the virus in the brain by animal inoculation.

Demonstration of Negri bodies

For the demonstration of Negri bodies search must be made in sections or impression preparations taken from the hippocampus major or from the oculomotor nucleus. Impressions may be stained by Giemsa's method after fixation by methyl alcohol. Sections may be fixed in Zenker's fluid, alcohol, or formalin and stained in hot alcoholic eosin solution followed by methylene blue. They may also be stained by Mann's method, and to demonstrate the finer internal structures Heidenhain's iron haematoxylin method may be used.

In performing a necropsy upon a dog suspected of being rabid every precaution should be taken to prevent accidental infection of the operator. The bones of the skull should be thoroughly broken before an incision is made. For animal inoculation any portion of grey matter will suffice, and this may be sent in 50 per cent glycerin to the nearest laboratory. For the demonstration of Negri bodies the hippocampus major, which lies in the floor of the lateral ventricle, and a portion of the mid-brain, including the oculomotor nucleus, should be dissected out and placed in a suitable fixative.

6.–TREATMENT

(1)—Prophylactic

This obviously depends on the control of the canine enzootic. To exclude rabies from a non-infected area the most rigid quarantine regulations should be enforced. Within an infected area licensing regulations should be applied and all unlicensed dogs destroyed. In many countries the prophylactic vaccination of dogs has proved efficacious. During a canine epizootic all dogs should be chained and muzzled. In countries where such measures can be only imperfectly applied the control of the disease even in a limited area has a considerable effect upon the prevalence of rabies within that area.

(2)—Pasteurian

Forms of fixed virus

The forms in which Pasteur's attenuated fixed virus is used for the immunization of persons bitten by rabid animals are manifold. The vaccines at present employed are as follows.

(i) Emulsions of spinal cords which have been desiccated for various periods over caustic potash—the original vaccine of Pasteur. For reasons of economy these after desiccation are usually stored in glycerin until required (Calmette).

(ii) Variously diluted suspensions of fresh medulla in saline (Högyes).

(iii) Suspensions of brain diluted in phenol saline (Fermi). The same but killed by heating at 37° C. for twenty-four hours (Semple). Puntoni used phenol vaccines of graduated virulence, the vaccines having been subjected to the action of phenol at 20° to 22° C. for various periods.

(iv) Ether vaccines are used by Alivisatos and Hempt. The former uses for the earlier doses vaccines which have been killed by ether, and for the later doses vaccines which still contain living virus. The modification as used by Hempt is both etherized and phenolized, and is dead.

(v) Vaccines which have been heated at temperatures of 45° to 60° C. were introduced by Babes and Piscariu.

(vi) Fermi used at Sassari a vaccine consisting of two parts of phenolized vaccine and one part of a potent antirabic serum from an immunized horse.

(vii) Vaccines treated by formalin, yatren, and other disinfectants have also been used.

(viii) Attempts have been made to concentrate the vaccine by removal of inert nerve substance. Volpino and Finocchio separated the nucleoproteins and had some success with a vaccine prepared from this material.

(ix) A tissue-culture vaccine has been prepared by Webster (1938) and tested with success upon dogs.

Some of these vaccines contain living, and others contain only dead virus. It appears that, when dosage is adjusted, the immunizing effects of living and dead vaccines are equivalent. The period of treatment varies from 7 to 25 days.

Results with various forms

That the results of the various methods of treatment do not differ materially from one another is evident from the following table derived from statistics submitted to the League of Nations from Pasteur institutes throughout the world and relating to the period 1927–35 (McKendrick, 1938):

Summary of Results of Various Methods of Pasteurian Treatment of Rabies

	Method	Numbers Treated	Deaths from Rabies Observed	Deaths from Rabies Calculated*	Mortality Per Cent
Europeans	Dried cords (Pasteur and Calmette)	53,773	77	82	0·14
	Dilutions (Högyes)	61,080	108	93	0·18
	Killed phenol (Semple)	55,644	82	84	0·15
	Live phenol (Puntoni)	3,464	6	5	0·17
	Fermi's phenol vaccine	6,500	13	10	0·20
	Fermi's serovaccine	390	0	0·6	0
	Heated (Babes and Piscariu)	93,145	154	141	0·17
	Ether-phenol (Hempt)	63,444	79	96	0·12
	Högyes and Alivisatos	49,656	60	75	0·12
	Dried cords and Fermi	2,671	7	4	0·26
	Yatren - -	5,384	13	8	0·24
	Total -	395,151	599	598·6	0·15
Non-Europeans†	Dried cords (Pasteur and Calmette)	56,044	341	351	0·61
	Dilutions (Högyes)	1,777	16	11	0·90
	Killed phenol (Semple)	280,696	1,761	1,756	0·63
	Total -	338,517	2,118	2,118	0·63

* Calculated from the average mortality for each race group, i.e. 0·15 in the case of Europeans and 0·63 in the case of non-Europeans.

† The race types are treated separately because they are clearly at different degrees of risk.

It also appears that the percentage mortalities among Europeans treated by living and by killed vaccines are 0·15 and 0·14 respectively, whereas in the case of non-Europeans the rates are 0·62 and 0·63. From these figures it appears that there is no evidence that any one method is superior to any other and, in particular, that with suitable dosage, killed vaccines are not inferior to vaccines containing living virus.

Neuro-paralytic sequelae of treatment

Certain neuro-paralytic sequelae in rare instances (1 in 5,441) follow antirabic treatment. These range in intensity from a local paresis to an ascending paraplegia of the Landry type and are seldom fatal. Their causation has been the subject of much controversy; they have been variously ascribed to the action of normal brain substance, to the action of a hypothetical toxin, to the chance presence of some other neurotropic vaccine, to anaphylaxis, and to abortive rabies. Their occurrence is much less common (1 in 9,702) after treatment by killed vaccines than after treatment by living vaccines (1 in 2,840).

Indications for vaccinal treatment

Diagnosis of rabies in the biting animal

The first question to be settled is whether the biting animal was rabid or not. The symptoms of rabies in the dog do not differ in essence from those in man. A change in disposition—snapping, hiding in dark corners, straying, inordinate affection—is the earliest sign. Fury speedily follows, the bark lacks its explosive beginning, the jaw may drop, and the gait is staggering. The excitable stage may be brief or entirely absent, in which case the dog sinks into the paralytic condition known as 'dumb rabies'. There may be difficulty in swallowing, symptoms of 'a bone in the throat', but hydrophobia is seldom observed. Death supervenes, and the diagnosis should be confirmed by examination for Negri bodies and by animal inoculation. A suspected dog should not be killed but should be kept under observation until the diagnosis is certain. If the dog cannot be traced, a history of an unprovoked assault, especially if a number of persons have been bitten, is important.

Diagnosis of bitten person's exposure to infection

The second question is whether the person has run the risk of infection. For the successful implantation of the virus upon nerve-endings trauma of the surface is necessary. Wounds or abrasions which have granulated for more than twenty-four hours may be considered as unbroken surfaces.

The procedure to be adopted by the practitioner is as follows. The diagnosis of rabies in the dog must be decided by keeping the dog securely chained and muzzled under observation. It should never be destroyed until a definite diagnosis has been made. If the dog remains alive and well for ten days, treatment of the patient is unnecessary. The bitten person should be sent *immediately* to the nearest vaccinating station if (i) the biting animal shows any abnormal symptoms and the person is bitten on the head or severely in any other part of the body, or (ii) if the animal has escaped or has been killed. The wound should first be washed and thoroughly cauterized.

(3)—General

In spite of the most extensive search no drug has been found to have any effect on the course of the disease or of the infection. For the alleviation of symptoms depressants of any sort may be used, e.g. chloral hydrate, morphine sulphate, chloroform inhalations, and bromides. Probably the most suitable depressant is atropine (which in the form of belladonna was used in rabies by Pliny) because it reduces throat spasm.

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Summaries by the author of over 1,300 contributions to the literature of rabies from 1924 to 1938 will be found in a series of 29 reviews published in the 3rd and 9th numbers of *Trop. Dis. Bull.*, **21** to **32** and **34** to **35** and the 3rd and 10th in **33**.

RACHITIS

See RICKETS, p. 661

RADIOLOGY IN DIAGNOSIS AND TREATMENT

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Reference may also be made to the following titles:

BRAIN TUMOUR
CANCER
KIDNEY, SURGICAL DISEASES
LABOUR: RADIOLOGY

1.–INTRODUCTION

1340.] X-rays travel in straight lines and cannot be reflected or focused. They undergo scattering or diffusion in a similar way to daylight. They also excite fluorescence in certain chemical compounds, e.g. barium platinocyanide, to a degree which depends on the intensity of radiation. This peculiarity provides the basis of the fluorescent screen used in X-ray examination.

Fluorescent screen

The rays can penetrate matter, but they are gradually absorbed in the process. The penetrating power of an X-ray beam depends on (i) the quality of the beam and (ii) the density of the material to be penetrated.

Quality or hardness of X-rays

Filtration

(i) The quality or hardness of the beam depends on the voltage at which the rays are generated and the filtration, i.e. the extent to which the less penetrating rays of the beam have been removed by absorption in a layer of a suitable absorbent or filter. High-voltage heavily filtered X-rays are used in deep therapy for their penetrating power. The usual voltage is 200,000 and the filter 1 to 2 millimetres of copper; but recently X-ray tubes have been made to work at voltages as high as one million in the treatment of malignant disease. At 200,000 volts and with suitable filtration, up to 50 per cent of the X-ray energy applied to the surface of the body may penetrate to a depth of 10 cm.

(ii) The denser the material to be penetrated, the more X-ray energy is absorbed and therefore the less the penetration. For this reason very dense materials, such as barium and lead, are used for protection against X-rays. It is the differential absorptive power of tissues of different densities that makes X-ray diagnosis possible. Much softer rays are used in diagnosis than in deep therapy, and the quality, usually generated from 40,000 to 100,000 volts, is selected to display to the best advantage the difference in absorptive power of the tissues to be examined.

2.–METHODS OF RADIOGRAPHY

Fluorescent screen

Photography

1341.] In diagnostic radiology the image of the part to be examined may be viewed on the fluorescent screen, or it may be recorded on a photographic film or paper. Neighbouring tissues differing greatly in density give the most striking contrasts, e.g. a solid mass embedded in the lung, and the separated fragments of a fractured bone with the intervening gap.

Contrast radiography

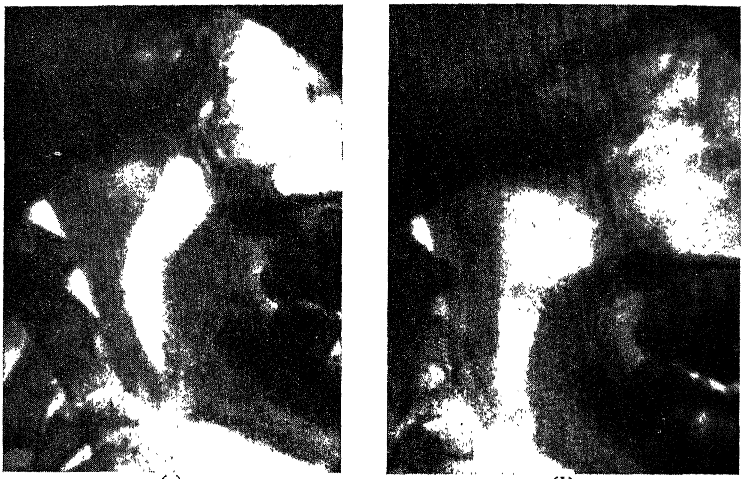
Contrast media

Less opaque

The outlines of a hollow viscus may be defined by filling it with an artificial contrast medium—contrast radiography as opposed to plain radiography. Contrast media, used to fill cavities, actual or potential, normal or due to disease or trauma, may be either less opaque or more opaque than the surrounding tissues. Substances less opaque than the surrounding tissues, e.g. air, carbon dioxide, oxygen, and nitrous oxide, are injected for ventriculography, encephalography, diagnostic pneumothorax, pneumoperitoneum, salpingography, and arthrography. Air normally present can also be used in radiography (see Figs. 31 and 32 and Plate III, A).

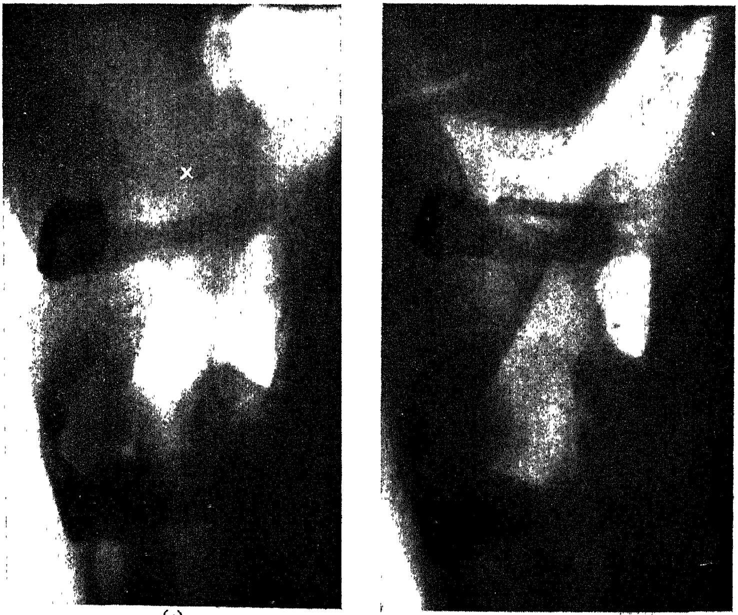
More opaque

Substances more opaque than the surrounding tissues include: (i) barium sulphate, given by mouth or by rectum for the gastro-intestinal



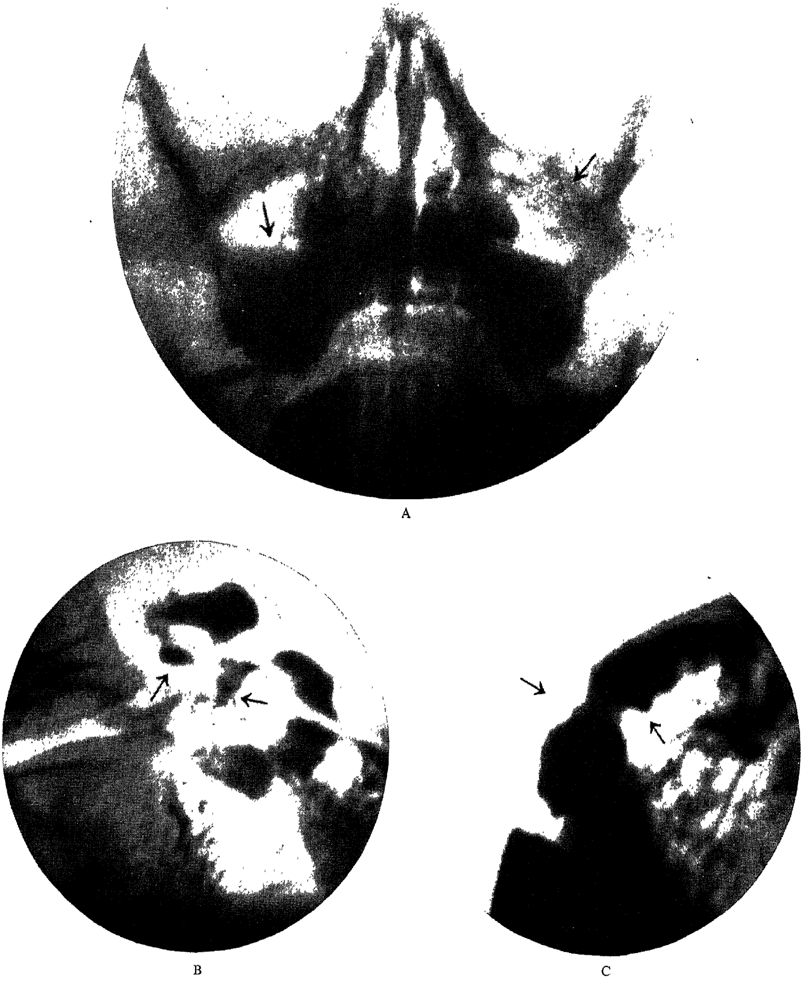
(a) (b)

FIG. 31.—Air in nasopharynx used as contrast medium to show (*a*) adenoids and (*b*) absence of opacity due to adenoids after operation



(a) (b)

FIG. 32.—Air in pharynx used as contrast medium to show soft tissues. Laryngeal mirror showed malignant tumour involving epiglottis but could not show downward extent. (*a*) Radiograph showing subglottic space filled and tumour, marked x, extending below level of hyoid bone. (*b*) Radiograph showing practically normal appearance after treatment



A. Air in maxillary sinuses (antra of Highmore) used as contrast medium to show localized swellings of lining membrane on floor of right sinus and on roof of left sinus in a child aged four. B and C. Radiographs of duodenal cap (Berg's method): B, right anterior oblique position, showing severe deformity of duodenal cap and two ulcer niches, towards which mucosal folds converge; C, left anterior oblique position, showing the two niches one on anterior and one on posterior wall of duodenal cap—'kissing ulcers' of Moynihan

PLATE III

tract (see Figs. 33, 35, and 36; and Plate III, B and C); (ii) iodized oil (iodine combined with poppy-seed oil), used in salpingography, sialography, bronchography, in tracing sinus tracks, and in the accessory sinuses of the nose; (iii) iodine-containing compounds excreted by the kidneys, e.g. uroselectan-B, per-abrodil, and hippuran, used in excretion urography, descending and ascending pyelography, arteriography, phlebography, and arthrography; (iv) iodine-containing compounds excreted by the liver, e.g. iodophthalein taken by the mouth or an isomer injected intravenously, collected in the gall-bladder, in cholecystography; and (v) a 12·5 per cent solution of sodium or potassium iodide, a satisfactory and economical means of outlining the renal pelves and calyces, ureters, bladder, or urethra by ascending pyelography.

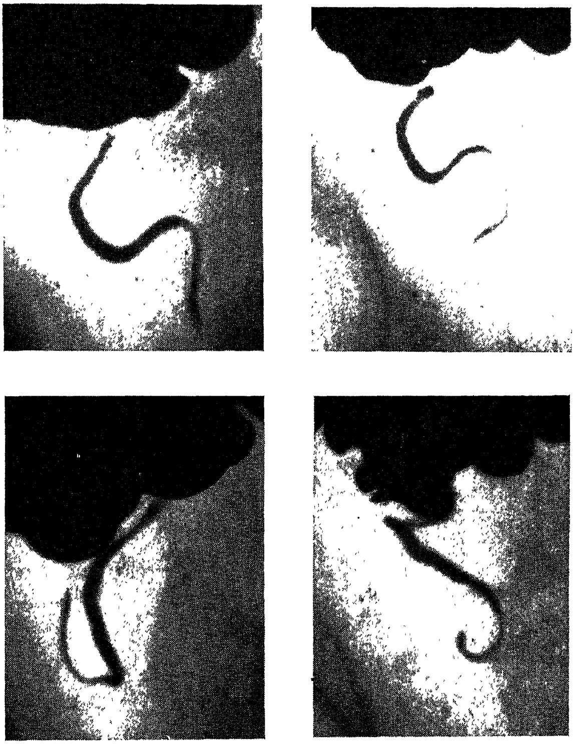


FIG. 33.—Radiographs of appendix after barium sulphate swallow, showing mobility of appendix

Salts of thorium have been used as contrast media but, being radioactive, they are dangerous and should be avoided.

Stereoscopic radiography

Stereoscopic radiographs are made by exposing two films, keeping the subject stationary between the exposures but moving the X-ray tube a distance of 6 cm., the interpupillary distance of the eyes. The films are examined in a stereoscope. The method is useful for giving rough spatial relations but is rarely used for exact measurement; it is most valuable in the examination of areas, e.g. the hips, where radiographs at right angles cannot be made.

Tomography

Tomography, planography, and stratigraphy are terms applied to various modifications of the same principle. Both tube and film, coupled with a lever, are moved about a fixed point in opposite directions during exposure; this movement blurs all layers except those in the plane of the axis of rotation and gives, as it were, a sectional radiograph. Cavities in lungs and bones and details in the spine and sternoclavicular and other joints which are invisible in plain radiographs can often be discerned (see Plate IV).

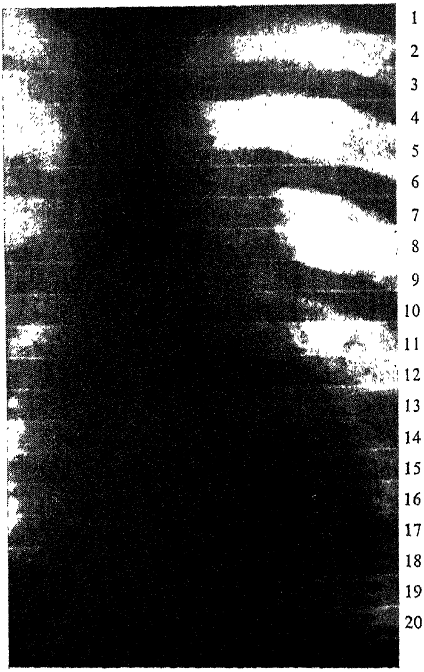


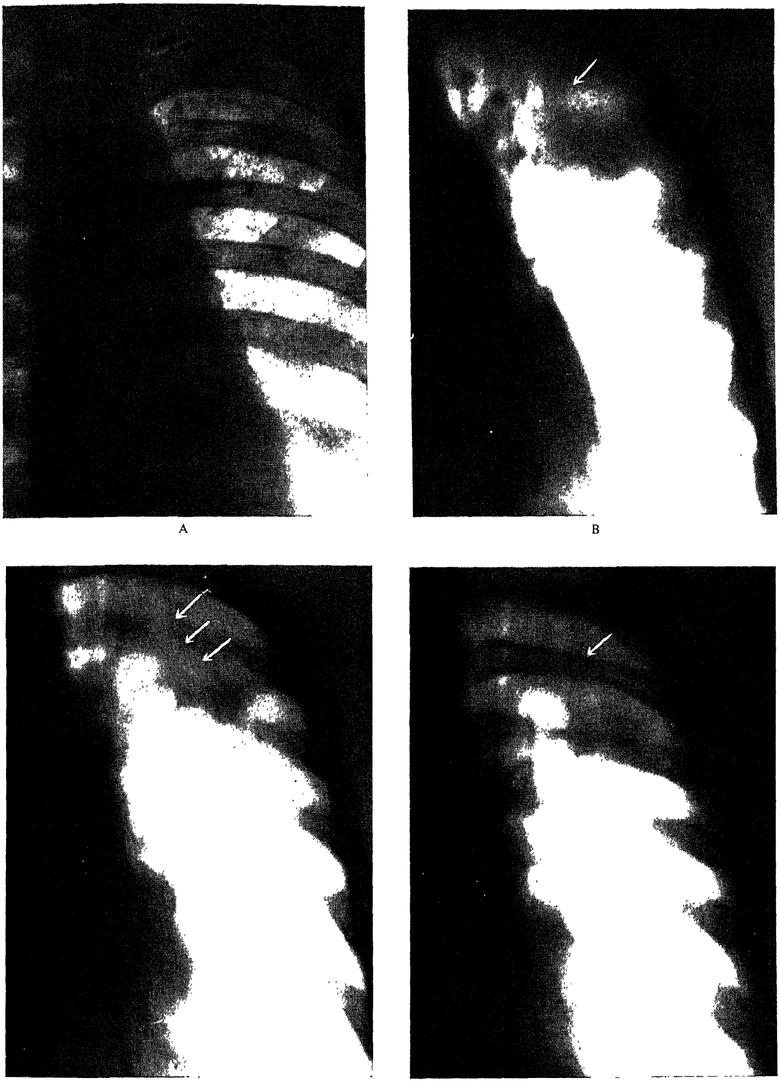
FIG. 34.—Kymograph of normal heart. A grid, formed of lead slats 1 cm. wide and 0·5 cm. apart, is moved during a 3-second exposure. Movement of edges of heart is shown in same way as record on a moving drum. Sections 2 to 6 show movements of aorta; 7 to 10 movements typical of left auricle; and 11 to 20 movements typical of left ventricle. On right side of heart right auricle and ventricle are superimposed

Kymography

Kymography records movement, which can be analysed and reproduced in the kymoscope. A grid, having narrow spaces (0·5 cm.) between lead slats (1 cm.), is moved at a steady rate for 1 cm. in front of a film during the exposure. Each section will show on the film the extent and form of movement in that portion (see Fig. 34). By comparison and measurement variations can be shown. Kymography is a reliable method of studying the movements of organs, especially the heart and aorta, and will record in detail the extent, direction, speed, duration, and time relationship of such movements.

Teleradiography

Teleradiography is radiography with the X-ray tube at a considerable distance, usually 6 feet, from the patient. The rays are almost parallel as they enter the body and diverge little in their passage through, thus reducing magnification or 'distortion' to negligible proportions.



A B C D

A. Plain radiograph of chest, showing ill defined opacities in left upper zone. No definite cavity is distinguished. B, C, D. Tomographs of same chest taken at depths of 10, 14, and 16 cm. respectively. Three small cavities are visible at 14 cm.; only one of them is visible at 10 cm.; and same cavity is also visible at 16 cm. Note also visibility of different ribs at different depths

PLATE IV

Cinematography *Direct* Cinematography has been applied to radiology. In the direct method full-size X-ray films are exposed at the rate of 8 to 16 per second and then reduced on to an ordinary cinematograph film. It is an expensive method owing to the number and size of films used. *Indirect* In the indirect method the fluorescent screen, lit up by X-rays, is photographed by an adapted cinematograph camera. The heart, voice, or other sounds can be simultaneously recorded or electrocardiograms made. The chief value of the method is in teaching students the movements of joints, heart, stomach, and diaphragm; so far it has not proved of great value in diagnosis.

3.–SYSTEMATIC RADIO-DIAGNOSIS

1342.] The use of X-rays in the demonstration of abnormalities and diseases of the various organs and tissues is discussed under the appropriate titles. In this article only a brief summary is given of the methods and results of radiography in the various systems of the body.

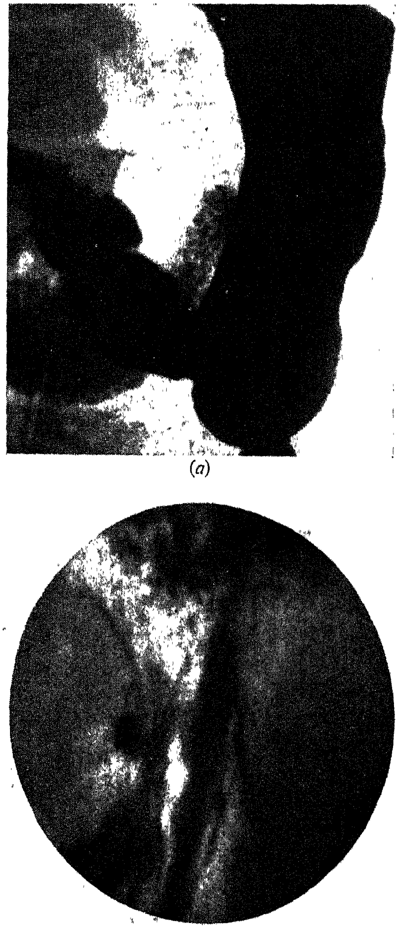
(1)—Alimentary Tract

Teeth Radiological examination of the teeth shows the presence of septic foci by making visible changes due to infection. It also demonstrates the number of teeth, erupted or unerupted, the direction of their roots, the presence of caries not seen on clinical examination, and the appearance of root-canal fillings and other stoppings.

Salivary glands Calculi in the submaxillary and sublingual glands are shown by plain radiography, but rarely those in the parotid gland. *Sialography* Sialography is contrast radiography (see p. 457) of the salivary ducts by means of iodized oil, which is injected into the parotid (Stensen's) or other duct. It is a valuable, safe, and painless method.

Pharynx and oesophagus *Barium sulphate swallow* In radiography of the pharynx and oesophagus a suspension of barium sulphate in water is used as a contrast medium. Although it is not essential, the patient should be examined fasting, preferably in the morning, for then food remnants are less likely to be present above an obstruction or in a diverticulum. An examination of the stomach should always be made whenever possible, so as to exclude a carcinoma of the fundus or a diaphragmatic hernia.

Stomach and duodenum In radiography of the stomach and duodenum the patient must be fasting at the time of examination, not having eaten or drunk anything since the previous evening. In the routine method the stomach is filled with a suspension of barium sulphate. The silhouette, tone, and mobility of the stomach and duodenum are studied on the fluorescent screen. Search is made for direct and indirect signs of ulceration, tumours, or other abnormality. In the methods due to H. H. Berg the study of the mucosal relief of the stomach and duodenum is an essential part of the examination. A thin contrast layer, one or two mouthfuls of the barium sulphate suspension, is first used for this purpose, after which the stomach is filled and the routine examination continued in the ordinary way. The Berg methods supplement the routine methods, and in them greater reliance is placed on the direct signs and their demonstration. (See Figs. 35 and 36 and Plates III, B and C, and V.)


(a)

(b)

FIG. 35.—Radiographs of stomach. (a) Stomach filled with barium sulphate and radiographed in oblique position does not show any abnormality. (b) Study of mucosal relief shows ulcer niche on posterior wall

Small intestine

After the stomach has been examined, the passage of the meal through the duodenum, jejunum, and ileum is watched by examinations at intervals. The common abnormal findings are (i) rapid passage due to carbohydrate dyspepsia (Hurst, see Vol. IV, p. 373), (ii) delay and dilatation due to obstruction, (iii) the string sign of regional ileitis, and (iv) diverticula.

Large intestine

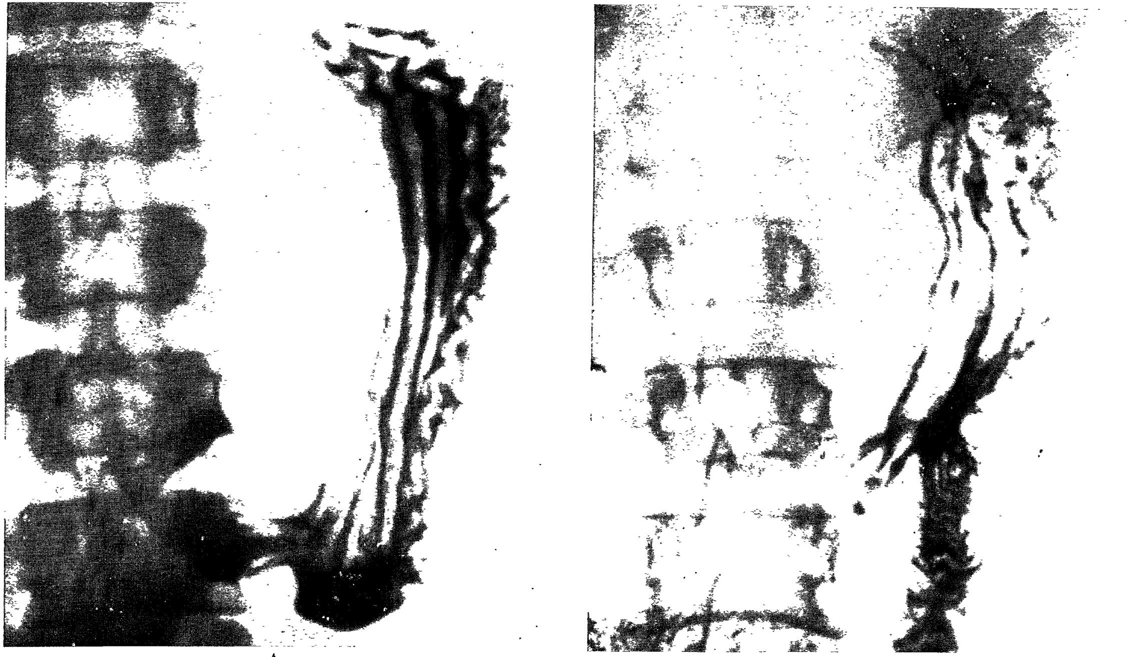
The rate of progress of the opaque meal through the colon gives information about the type of constipation. The examination for organic disease is best carried out by an opaque enema, not by the barium sulphate meal.

Opaque enema

The patient need not be fasting. The large bowel is cleansed by colonic lavage until the returned fluid is clear. Purgatives, which may produce increased bowel movement, should not be given. The opaque enema is injected an hour or so after the lavage and is observed in its passage from anus to caecum, and radiographs are made. After evacuation a further film is made.

Double contrast

It is often useful to follow this by the double contrast method, i.e. distension of the colon with air, sufficient barium sulphate being usually left behind to show whether or not the colon is distensible. Occasionally the intraluminal shadows of polypi will be found, when not shown in the barium sulphate filling. The distension of the



A

B

Radiographs of stomach (Berg's method). A. Mucosal relief shows folds normal in direction and width. B. Mucosal relief shows slightly widened folds. Gastro-enterostomy has been performed; opening is clearly visible

PLATE V

[*To face p.* 462

colon by air causes considerable discomfort and should not be imposed on ill patients or if there is any danger of perforating a paper-thin gut or diverticulum. It should be reserved for difficult cases and not used as a routine procedure.

Gall-bladder

The gall-bladder is not usually seen in the plain radiograph, unless it is calcified. Less than 40 per cent of gall-stones contain sufficient calcium to be shown in the plain film.

Cholecystography

Cholecystography is a satisfactory method of examination and in skilled hands shows a 90 per cent degree of accuracy. The iodine-containing compound which is to be excreted by the liver and concentrated in the gall-bladder can be given by mouth or injected intravenously. The oral method is the easier and usually disturbs the patient less. The intravenous route is best used to check the findings of the oral method or in cases in which vomiting or diarrhoea prevents absorption of the drug. (See also Vol. V, p. 486.)

Contra-indications

Contra-indications are liver disease and jaundice.

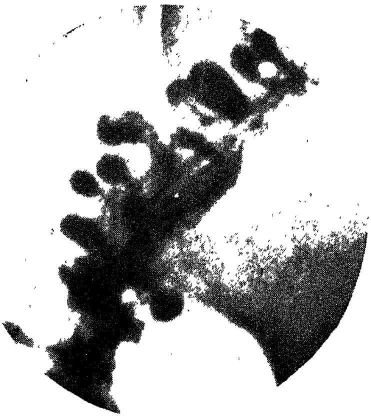


FIG. 36.—Radiograph of descending colon by Berg's mucosal relief method, showing diverticula

Oral method

A solution of sodium tetraiodophenolphthalein is swallowed by the patient, preferably while in bed, an hour after taking a fat-free meal. Thereafter fluids, such as water and coffee and tea without milk, can be taken, but no solid food. The first film is made fourteen hours after taking the drug, the patient still fasting. Two hours later another radiograph is made, and after this a fat-containing meal—eggs and bacon or two eggs beaten up in milk—is taken. Thirty to forty-five minutes later the gall-bladder is re-examined and the degree of contraction observed. Calculi are often more clearly seen at this time.

Intravenous method

If the intravenous route is used, the isomer sodium phenoltetraiodophthalein is injected about an hour after a fat-free meal in the evening. This compound is intensely irritating if it escapes into the tissues. General reactions are often greater than by the oral route and phlebitis is an occasional sequel.

If normal shadows are obtained with good radiographs, disease of the gall-bladder and gall-stones are unlikely to be present. Faint shadows and absence of shadow, provided that the drug has been properly prepared, taken, and absorbed, and that there is no disease of the liver, suggest that the gall-bladder is not concentrating, because its walls are diseased, e.g. cholecystitis, or because the drug is not reaching the gall-bladder, the hepatic or cystic duct being blocked by a calculus or otherwise obstructed. Peptic ulcer or other organic disease of the stomach or duodenum occasionally appears to prevent filling of a normal gall-bladder, but this is not common.

(2)—Respiratory Tract

Nasopharynx

Radiographs of the nasopharynx show the presence or absence of adenoids (see Fig. 31).

Accessory nasal sinuses

Plain radiographs, if of good quality, give satisfactory evidence of infection and other disease of the accessory nasal sinuses. The air-displacement method of Proetz, by which iodized oil is allowed to run in to take the place of the air removed by suction, demonstrates the actual cavity and so the thickness of the lining membrane. It also shows the rate at which the sinuses empty.

Larynx

The larynx is best shown by a plain radiograph in the lateral position. X-rays rarely supply a diagnosis that cannot be made by laryngoscopy, but the extent of a growth and its response to treatment can be observed.

Lungs and bronchi

Broncho-graphy

The lungs and bronchi are accessible to X-ray investigation and often show radiological evidence of disease before ordinary physical signs can be elicited. Bronchography must be used for the detection of bronchiectasis, or of obstruction by tumour of the bronchi; this involves the injection, after cocainization, of iodized oil into the trachea by a nasal catheter, by a laryngeal syringe inserted between the vocal cords, or directly into the trachea from outside by puncture, between the thyroid and cricoid cartilages. It is an unpleasant experience for the patient in even the most expert hands, but it affords evidence obtainable in no other way.

Artificial pneumothorax

An artificial pneumothorax may be induced to show whether an opacity is in the collapsed lung or extrapulmonary.

Tomography

Tomography (see p. 460) often demonstrates cavities, whether tuberculous or due to abscess, and enlarged hilar glands which cannot be seen in the plain radiograph.

(3)—Circulatory System

Heart

Teleradiography (see p. 460) demonstrates the size of the heart more accurately than does percussion. Accurate measurement, however, is unsatisfactory, there being too many inconstant factors, but a rough yet sufficiently satisfactory idea of the size can be obtained.

Kymography

Kymography (see p. 460) is valuable, e.g. in the demonstration of size and position of infarcts and in the differentiation of tumours from aneurysm.

Arteriography and phlebography

Plain radiographs of the limbs can demonstrate calcification of the arteries. The injection of uroselectan-B or of per-abrodil into an artery, e.g. the femoral, makes possible the demonstration of such conditions as aneurysmal dilatation or occlusion by atheromatous plaques or by spasm. Injection into veins can show varicosity or obstruction.

(4)—Renal Tract

The shape, size, and position of the kidneys can, in most cases, be demonstrated by plain radiography. The relation of opacities to the kidneys and the effect of respiration upon them can be studied. Much more valuable information, however, is given by contrast radiography. Uroselectan-B or per-abrodil is injected intravenously. The opaque medium begins to be excreted usually within five minutes, and all of it has passed through the kidneys and is in the bladder within sixty minutes. Variation from these times points to a morbid condition. In the great majority of cases, the injection does not cause any constitutional symptoms, and although a little spasm may be felt in the arm and shoulder towards the end of the examination it passes off within a few minutes and is seldom severe. No preparation is necessary, and the best results are obtained in ambulant patients.

Excretion urography

This method supplies both anatomical and physiological information. The shape of the renal pelves and calyces is shown. An opacity due to a calculus can be seen to lie inside the shadow of the pelvis or of a calyx. If an opacity, due perhaps to calcified tuberculous debris, is present in the kidney, its relation to the renal outline remains constant when examined during expiration and during inspiration. In most cases it is possible to localize an opacity as being in or outside the ureter. If a calculus is present, not only are the shape, size, and position shown but also any hydronephrosis, inflammatory changes, and interference with excretory function. The presence of a non-opaque calculus in the ureter can also be deduced.

Information obtainable

When no excretion occurs on one side, or if unsatisfactory urograms are obtained, it is advisable to make an ascending pyelogram. This involves the use of an operating cystoscope, the passage through it of ureteric catheters, and the filling of the renal pelves and calyces with an opaque solution, e.g. 12·5 per cent sodium or potassium iodide. The danger of over-distension and resultant extravasation of the opaque medium into the renal parenchyma may be avoided by proper care.

Ascending pyelography

Hippuran can be administered by mouth, but, because the stomach lies over the kidneys, and any retained opaque solution masks the area to be examined, it is really of value only to delineate the bladder when an instrument cannot be passed. Its use *per rectum* and subcutaneously has not found favour.

Hippuran

(5)—Female Genital Tract

Air or, much more satisfactorily, iodized oil is injected into the uterus through the cervix. If the iodized oil is seen later free in the abdominal cavity, there can be no obstruction in the uterus or uterine (Fallopian) tubes to account for sterility. (For radiography in pregnancy see Vol. VII, p. 584.)

Salpingography

Pregnancy

(6)—Nervous System

Plain radiographs of the skull and spine show changes due to erosion of bone, to the deposit of calcium, or to the displacement of structures

Ventriculography

Encephalography

Cerebral arteriography

Myelography

by a tumour, e.g. pineal shift (see Vol. IX, p. 598). In many cases, however, diagnosis and, more especially, localization can only be made by more complicated and more dangerous procedures: (i) in ventriculography a trephine opening is made in the skull, and air is injected through a needle into the lateral ventricles (see Vol. II, p. 632, Plates IX, X, XI, and XII); (ii) in encephalography, by means of a lumbar puncture, air is allowed to take the place of cerebrospinal fluid; it then rises and fills the ventricles and subarachnoid space of the skull; these processes demonstrate obstruction and displacement by tumours in the brain; (iii) cerebral arteriography may localize a tumour by demonstrating displacement of groups of arteries, and sometimes a peculiar type of distribution is shown, typical of certain tumours; thorotrast, a stabilized thorium dioxide sol, 3 to 4 c.c. is injected into one of the carotid arteries; and (iv) myelography, the injection of iodized oil, thorotrast, air, or nitrous oxide into the subarachnoid space by lumbar puncture from below or into the cisterna magna from above. The contrast medium is allowed to ascend or descend the spinal canal with the assistance of gravity. A tumour arrests the flow, and the level is indicated on the radiograph.

These are difficult examinations, not without danger and discomfort, and should not be undertaken lightly by inexperienced hands.

4.–RADIOTHERAPY

(1)—X-Ray Therapy

Types of X-rays used

Superficial therapy

Deep therapy

'Super' high-voltage therapy

1343.] From this point of view X-ray treatment may be divided into (i) superficial therapy; (ii) deep or high-voltage therapy; and (iii) 'super' high-voltage therapy. Superficial therapy is used for lesions of the skin and subcutaneous tissues; the X-rays are produced at voltages of 40,000 to 100,000 and are used without filtration, or with only light filtration (1 to 2 mm. aluminium). Deep therapy is used for lesions at any depth in the tissues; the rays are produced at voltages of 180,000 to 250,000 or higher. While physical considerations alone impose the use of these high-voltage rays in the treatment of deeply-lying lesions, many authorities believe that the high-voltage X-rays are also more effective, dose for dose, in the treatment of malignant tumours. For this reason malignant tumours even when very superficial are usually treated by deep therapy and not by superficial therapy. This belief, moreover, has led to the trial of 'super' high voltages, up to one million, in the treatment of malignant tumours. The results of this treatment have still to be determined.

Contact therapy

Soft (low-voltage) rays in high intensities at short distances (3 to 5 cm.) from the skin have been advocated in superficial malignant tumours and in deeply situated tumours exposed at operation. For this method, introduced by Chaoul, it is claimed that the results compare favourably with those of high-voltage X-rays, and it is simpler and more economical.

Dosage

Unit of dosage

Factors in dosage

The absolute unit of X-ray energy is the r or roentgen. The local effect on the tissues of a given number of r depends on (i) the tissue irradiated, the radio-sensitivity of different tissues varying greatly; (ii) the quality of ray; and (iii) the length of time of application. Thus 1,000 r of high-voltage X-rays suitably filtered given at one application produces a conspicuous skin erythema, whereas more than twice this dose is required to produce the same effect if it is given in equal daily fractions over a fortnight. There is reason to believe that the other normal tissues show much the same variations as the skin as regards the time factor. It is not known, however, if the variations in sensitivity of pathological tissues, such as malignant tumours, to divided dosage run parallel with those of the normal tissues; but in malignant tumours, at any rate, there is reason to believe that they do not. The aim of the divided-dose technique in X-ray therapy is to exploit to the full any difference that may exist in the tolerance of the normal and malignant tissues to the disadvantage of the latter. Experience, backed by experimental evidence, suggests that the application of the separate doses of X-rays at intervals of approximately twenty-four hours, with a total treatment-period of two to four or even six weeks, gives the best results in malignant tumours. In general, the more rapidly growing the tumour, the shorter should be the duration of the treatment. About 4,000 to 5,000 r over four weeks is regarded as a lethal dose for the more radio-sensitive carcinomas. These doses cause considerable reactions in the skin and mucous membranes, and, if the dose has to be distributed over any wide region, especially the abdomen, the general effects of the treatment are severe.

Effects of X-rays on normal tissues

(i) *Skin*

Acute X-ray dermatitis

Exposure to therapeutic irradiation, i.e. to heavy dosage within a short space of time as described above, produces changes in the skin, depending on the dose, comparable with those produced by ordinary heat burns. Degrees of acute X-ray dermatitis are recognized as corresponding roughly to the degrees of heat burns (see Vol. II, p. 720), with the exception that in the fourth-degree X-ray burn sloughing extends more deeply. First-, second-, and third-degree skin reactions heal rapidly with the correct treatment, but some permanent change nearly always remains in the form of dryness of the skin, pigmentation, and, in the third-degree cases, epilation. Temporary epilation is a characteristic of first- and second-degree reactions.

Chronic X-ray dermatitis

Chronic X-ray dermatitis results not from therapeutic but from accidental exposure to very small doses of X-rays over a long period. It is an occupational disease and differs from acute X-ray dermatitis in its manifestations, being characterized by thickening and hyperkeratosis, with the formation of warty growths and extremely painful fissures of the skin, and hypertrophic changes in the nail-fold and nail-bed, which may result in the shedding of the nail. Squamous-celled carcinoma often

Squamous-celled carcinoma arises from a wart or a fissure in chronic X-ray dermatitis; it never occurs as a result of acute dermatitis from therapeutic exposure.

Telangiectases *Pigmentation* *Ulcers* Certain late effects of X-rays on the skin are recognized; the commonest are: (i) telangiectases, which may appear months or years after the treatment; (ii) pigmentation, which may be patchy or uniform; and (iii) variations in the colour of the re-grown hair. Necrotic ulcers may appear at a late stage after X-ray treatment, probably as a result of infection of the devitalized tissue. Their green sloughing base and a punched-out margin with a narrow hyperaemic rim are characteristic.

Treatment during irradiation The less medication applied to the skin during X-ray treatment, the better. Oily and fatty applications are undesirable, and preparations containing heavy metals, e.g. zinc oxide powder, should be rigorously avoided. Irritation may be allayed by dusting with a simple starch powder. All irritation, mechanical, thermal, or chemical, to the skin that is being irradiated must be carefully avoided. Fomentations, irritant preparations, and hot-water bottles come under these headings.

Treatment of X-ray dermatitis After X-ray treatment irritation is allayed by a dusting powder of zinc oxide, bismuth subchloride, and starch. Blisters may be treated by a mixture of zinc oxide and castor oil, and larger excoriations by emulsion of acriflavine. Skin reactions which fail to heal within two or three weeks may be treated with a 1 per cent solution of tannic acid in mercuric chloride 1 in 2,000, the dressing being left *in situ* for several days at a time. Chronic X-ray ulcers and late reactions may also be treated with this preparation after gross sepsis has been eliminated. Fourth-degree reactions (true X-ray burns) should be excised if possible. Chronic X-ray dermatitis is treated on general principles, intractable fissures and warts being excised.

(ii) *Blood*

Massive doses The effects on the blood differ according to the nature of exposure: (*a*) to massive doses within a short time or (*b*) to repeated very small doses over a long period (occupational exposure). Massive doses result in slight to moderate reduction in the red cells and haemoglobin and in total leucopenia with a relative lymphopenia. A fall in total white cells to below 1,200 per cubic millimetre or of lymphocytes to 200 should be regarded as an indication for the cessation of the treatment.

Repeated small doses The results of chronic exposure are an initial increase in the red cells, an initial increase in haemoglobin, with a colour index which tends to rise, and an initial slight increase in total leucocytes, with a shift towards equality in the ratio of the polymorphonuclear to the mononuclear cells. In the later stages of chronic X-ray exposure the changes are similar to those observed with massive doses.

Aplastic anaemia Aplastic anaemia may be a terminal stage of either form of exposure. The blood shows absence of all nucleated red cells, indicating complete failure of the marrow functions.

Treatment The effects of X-rays on the blood, though rarely severe in modern X-ray therapy, are best combated by the administration of iron, or liver and iron. Recognition of the effects of chronic exposure in the initial stages demands a holiday from X-ray work and a careful search for any fault in protection or for careless habits leading to undue exposure. In the later stages X-ray work must be given up altogether.

(iii) *Genital system*

Sterility

Sterility can be produced in both sexes by X-rays, either by massive doses, as in therapeutic exposure, or by repeated small doses, as in occupational exposure. In both types and in both sexes such sterility can be recovered from. The onset of sterility in the female is accompanied by the usual menopausal symptoms, which are the more severe the younger the patient. There is a difference of opinion whether or not there is a danger of inherited damage to the children born after recovery from X-ray sterility; experiments on animals suggest that no definite answer can be given to this question until the effect on several generations has been observed.

X-ray sickness

This occurs during and immediately after X-ray treatment and is characterized by headache, malaise, nausea, and often vomiting. It occurs with heavy X-ray dosage, especially when applied to the upper abdomen. The mode of production is unknown. The liver and adrenals have been blamed, but the condition may occur when these glands are outside the X-ray field. Severe forms of this condition are rare now, but they were formerly common, sometimes proving fatal. Nausea, the commonest manifestation, can usually be relieved by the oral administration of solution of adrenaline hydrochloride in 10-minim doses in water at frequent intervals. More severe cases often yield to chlorbutol in 10-grain doses. The injection of liver preparations is also valuable in some cases.

Protection against X-rays

Patient

Personnel

With modern shock-proof apparatus protection from electrical hazards is scarcely required. Protection from X-rays concerns both the patient and the personnel of the department. The greatest possible care must be taken to protect the patient from unnecessary exposure either to scattered radiation or to the direct beam. For this purpose sheets of lead or of rubber impregnated with lead salts are used. The protection of the personnel is effected by a proper design of the X-ray apparatus used in diagnostic work and by complete lead enclosure of the treatment cubicle, the operator remaining outside and viewing the patient through a lead-glass window during exposure. A strict discipline should be imposed upon all those handling X-ray apparatus, so as to obviate the formation of bad habits which may lead to unnecessary exposure to the X-rays. Blood counts should be carried out at fixed intervals upon all those engaged in radiological work.

(2)—Radium Therapy

Definition

Radium

Radium is one of a series of radio-active elements, i.e. elements which undergo steady and continuous disintegration with the emission of certain radiations; it is the first link in one chain of radio-active elements of which the next disintegration product is radium emanation or radon. For practical purposes, both radium and radon give out the same radiations; but, whereas radium disintegrates very slowly, only falling to half its original value in 1,690 years, radon is short-lived, falling to half its value in 3·85 days.

Radium emanation or radon

Alpha rays

Radium and radon give off three kinds of radiations. The alpha rays are comparatively slow-moving, positively-charged particles with such slight penetrating power as to render them of little or no value in medicine. The beta rays are much faster-moving, negatively-charged particles with a higher penetrating power, up to a centimetre or so of tissue. They are occasionally used in the treatment of very superficial lesions. The gamma rays are the therapeutically important radiations and are of the same nature as X-rays but shorter in wave-length than those in general use in X-ray therapy. Their biological effects are similar to those of X-rays, but the difference in the mode of production imposes the use of different techniques in treatment. In interstitial radium therapy the superimposition of the trauma upon the radiation effects may result in more serious injury as the result of overdosage. Persistent painful necrotic ulcers of the skin and especially of mucous surfaces may thus be caused.

Beta rays

Gamma rays

Methods of application

There are four methods of therapeutic application of radium: interstitial, intracavitary, short-distance, and long-distance.

Interstitial radium therapy

In the interstitial method the radium is encased in metal needles of a sufficient wall-thickness (0·5 mm. platinum) to filter off all the alpha and nearly all the beta rays. These needles are inserted directly into the tissues and are arranged in a carefully planned geometrical pattern so as to provide uniformity of dosage. The needles may be left *in situ* for several days before removal. Needles for interstitial therapy may contain from 0·25 mgm. to several milligrams of radium.

Intracavitary radium therapy

In intracavitary radium therapy the radium, again filtered by not less than 0·5 mm. platinum or its equivalent, is enclosed in a soft packing, such as rubber or gauze, and inserted into a body cavity, e.g. the rectum. Up to 50 or even more mgm. of radium may be used in this method.

Short-distance surface radium therapy

In short-distance surface radium therapy the radium is applied on small flat metal applicators either directly to the skin or at a distance of a centimetre or so from it. Usually only the gamma rays, but occasionally the beta rays, are used.

Alternatively moulds of columbia paste or nidrose are used which have been made to fit accurately the surface of the region to be treated. The radium is distributed in several foci over the surface of the mould, and the radium-skin distance may be 2 to 5 cm. Such apparatus may be worn by the patient for several hours every day, until the requisite dosage has been given. Up to 200 or 300 mgm. may be used in this method; gamma rays only are employed.

Long-distance radium therapy

Long-distance radium therapy, telecurie therapy, and bomb or beam therapy are synonymous terms. The radium, usually several grams, is contained in a heavily protected receptacle, with an exit for the gamma rays. The bomb is used at a distance of 6 to 10 cm. from the skin in precisely the same way as an X-ray tube. In the bomb technique for malignant tumours treatment is usually applied daily for several weeks, as in deep X-ray therapy.

Radon

Radon may be used instead of radium whenever the rapid disintegration of this substance is not a contra-indication. Thus radon is convenient in interstitial radium therapy and in short-distance therapy with flat applicators, in which the times of irradiation are short; but in bomb therapy, in which the irradiation times are prolonged, radium must be used.

Dosage

Unit of dosage

The unit of radium dosage was formerly the milligram-hour, which, however, is very inaccurate. Much more accurate systems of dosage have since been based on the r unit, as used in X-ray therapy. Owing to the difference in the quality of ray, about one and a half or more times the number of radium gamma-ray r must be given to produce the same biological effect as a given number of X-ray r (200,000 volts) in the treatment of malignant tumours. Radium dosage expressed in r is therefore from fifty to a hundred per cent higher than that given in deep X-ray therapy.

(3)—Mode of Action

Acute inflammations

In the treatment of acute inflammations the mode of action of radiations is unknown. Clinical doses do not directly destroy bacteria. A temporary increase in inflammation may produce more antibodies. In the treatment of chronic inflammations radiations are said to act by destroying the lymphocytes which pack the tissue spaces, the removal of the dead cells and the relief of tension contributing to produce a moderate hyperaemia. In this way an infecting organism is more actively dealt with. Radiations therefore produce an active hyperaemia, with effects that may be compared with those which it is attempted to produce in Bier's passive hyperaemia.

Chronic inflammations

Malignant tumours

In the treatment of malignant tumours opinion is divided on the question whether the effect is mainly on the tumour cells or on the tumour bed. There is no doubt that sufficient doses of radiations cause lethal effects in malignant cells, and it is equally clear that the response of the tumour bed to irradiation has an important influence on the

Relative radio-sensitivity

result. Malignant cells are in general more radio-sensitive than normal tissues because of their more active growth and, perhaps, their less perfect blood-supply. In general, the more primitive and undifferentiated the cell the more radio-sensitive it is. Thus lymphosarcoma is one of the most radio-sensitive tumours known, whereas fibrosarcoma is one of the most radio-resistant. Similarly, highly keratinized tumours of the skin or of mucous surfaces tend to be radio-resistant, whereas more cellular tumours of the same surfaces tend to be radio-sensitive.

(4)—Clinical Applications

Skin

Hypertrichosis is often treated by either X-rays or radium; but permanent epilation cannot be produced by radiations without a grave risk of the late changes referred to on page 468. Hyperidrosis is successfully treated by X-rays. Warts and corns respond well to either X-rays or radium, and keloid scars do best with X-rays. Naevi require prolonged and skilful treatment by surface radium. The results are very good. Rodent ulcers and epitheliomas are treated by X-rays or by radium, according to the special indications. The results in rodent ulcers unattached to bone or to cartilage are excellent, and surgical treatment should never be used in such cases. The results in squamous-celled carcinoma, with the same reservations, are almost as good.

Diseases of the blood-forming organs

Erythraemia

Leukaemia

X-rays are used for the enlarged thymus in status lymphaticus and in myasthenia gravis. In erythraemia (Vaquez-Osler) X-rays have been applied to the spleen and long bones, but only moderate and temporary benefit is obtained. In chronic leukaemia X-rays give good palliative results, the cells being reduced to normal total numbers and more normal proportions in both the lymphoid and myeloid types. Considerable skill and judgement are required if the best results are to be obtained with safety in this treatment. In acute leukaemia radiations are valueless.

Hodgkin's disease

In Hodgkin's disease radiations are of great palliative value, life often being prolonged for many years, even up to fifteen or twenty; the swellings and infiltrations yield readily to X-ray treatment, and the toxaemia is controlled for a long time. By a recently described method (Levitt) treatment by X-rays can be employed even when the disease has generalized and is in an advanced stage.

Nose and mouth

Salivary cysts and fistulae can be cured by X-rays, because of the great radio-sensitivity of the parenchyma of the salivary glands, which is rendered functionless by quite moderate doses. Parotid tumours give moderately good results with either X-rays or radium bomb, the best results being obtained from a combination of operation with irradiation. In carcinoma of the lip, tongue, and tonsil the best results are given by the radium bomb, whereas tumours of the palate and post-nasal space give good results with X-rays, even when the cervical glands are affected.

Laryngeal tumours

Extrinsic laryngeal tumours should be treated by the radium bomb, whereas intrinsic laryngeal tumours do well with X-rays or with radium, either by the interstitial method ('fenestration method' of Finzi and Harmer) or by the bomb.

Cervical glands

Metastases in cervical glands are among the most radio-resistant tumours known, except when due to sarcomas or carcinomas of the palate or in the post-nasal space. The latter cases may be treated by X-rays or by radium; but in the radio-resistant types the radium bomb is preferable. In carcinoma of the oesophagus the prognosis has recently been greatly improved by the introduction of a special method of X-ray treatment (Levitt). Swallowing is restored in 50 to 60 per cent of cases, and some patients survive for several years; but it is too early to assess fully the value of the method. (See Fig. 37.)

Carcinoma of oesophagus

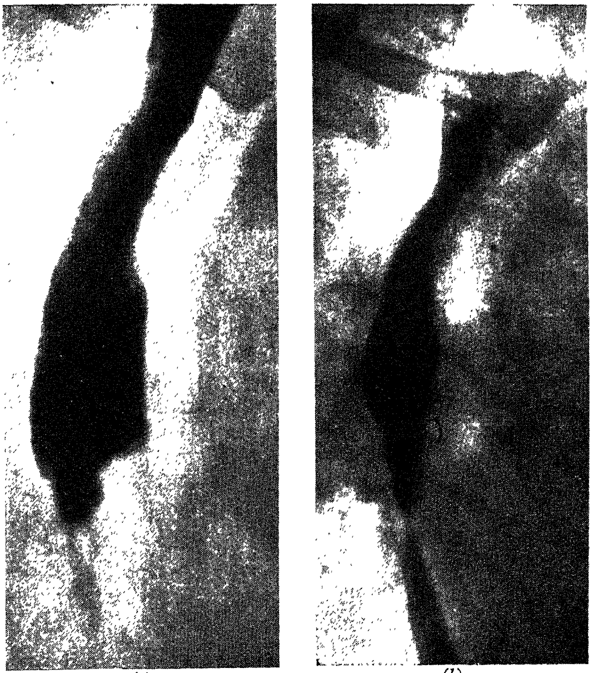

(a) (b)

FIG. 37.—Radiographs of carcinoma of oesophagus. (a) Before treatment. (b) One year after treatment, showing conversion of tumour into fibrous stricture

Stomach and intestines

The stomach and the small and large intestines afford little scope for radiotherapy. Carcinoma of the rectum has yielded a small proportion of successes from interstitial radium therapy and from intracavitary radium therapy in combination with deep X-ray therapy.

Respiratory system

Bronchial carcinoma gives very poor results from X-ray therapy. Very striking initial successes are obtained, but eventually death from recurrence or from metastases almost invariably follows. Endothelioma of the pleura is often radio-sensitive and is best treated by X-rays. Mediastinal tumours often give very good and lasting results with X-ray therapy.

Breast

Chronic mastitis often yields to small doses of X-rays applied at intervals of a few days. Carcinoma of the breast is often radio-sensitive, giving good initial results with interstitial radium or with X-ray therapy. Whether or not these results are as lasting as those of surgery remains to be seen, and the modern tendency is to use a combination of surgical and post-operative X-ray treatments for all operable cases and X-ray therapy for inoperable cases. There is, however, no doubt that in skilled and experienced hands the results of radium compare favourably with those of surgery (Keynes).

Urinary system

There is reason to believe that the results of operation in carcinoma of the kidney are improved by post-operative X-ray therapy. The so-called Wilms' tumours in children and adults, in common with other retroperitoneal tumours in children, do very well with X-ray therapy, although it is usually considered safer to explore subsequently and to remove any remnant that may be found. Such tumours, however, should always be treated in the first instance by X-rays.

Bladder and prostate

Carcinomas of the bladder and of the prostate give good palliative results with X-ray therapy. Apparent cures (five and ten years' freedom from recurrence) are occasionally obtained, especially in the prostatic tumours. Radium has proved disappointing and not free from danger in these cases.

Testes

Testicular tumours are usually highly radio-sensitive. Every case in which a testis has been removed for carcinoma should be given post-operative irradiation to the pelvis and homolateral lumbar glands. Even advanced cases with generalized disease may be given several years of life by X-ray therapy.

Penis

Carcinoma of the penis is often radio-sensitive, and the primary tumour yields well to either X-rays or radium. Glandular metastases, however, tend to be radio-resistant.

Female genital system

Radiotherapy affords a simple and certain means of inducing an artificial menopause. Either X-rays or radium may be used, but the former offer certain advantages. Above the age of forty or so the menopause symptoms do not differ from those of the normal menopause; but under this age the symptoms are the more severe the younger the patient, and the treatment should not be carried out except as a life-saving procedure or as an alternative to hysterectomy or oophorectomy. Artificial menopause is induced in cases of severe functional haemorrhage, and it is an essential part of the radiation treatment of fibroids and of endometriomas. In women under the age of thirty-five a temporary artificial menopause may be produced. Carcinoma of the cervix should be treated by a combination of intracavitary radium with deep X-ray therapy, and carcinoma of the body of the uterus by a combination of surgery and deep X-ray therapy. Ovarian cysts are usually radio-resistant and give poor results from radiotherapy, whereas solid ovarian tumours are often highly radio-sensitive. Carcinomas of the vulva and of the vagina are, as a rule, radio-resistant. Inoperable cases are usually treated by interstitial radium or, in the case of the vulva, by the new Chaoul method.

Bones and joints

Tuberculous disease of bones and joints is sometimes treated by small doses of X-rays, and the treatment appears to be of value in some cases of tuberculous joints. Osteitis deformans is unaffected by radiation therapy. Good results are frequently obtained in giant-celled tumour, especially in the pelvis. Periosteal sarcoma usually does not respond to radiotherapy. Ewing's sarcoma is invariably highly radio-sensitive, and deep X-ray therapy gives some very good results. Chondro-sarcoma is often radio-sensitive. In any of these conditions a satisfactory result from radiotherapy is often not accompanied by shrinkage of the swelling, the repair process often taking the form of a massive calcification of the whole tumour. Secondary deposits in bone, when isolated, especially those resulting from carcinoma of the breast, give very good results from deep X-ray therapy. Even when pathological fracture has occurred, healing is often satisfactory.

Nervous system

X-rays are sometimes applied to the choroid plexuses to produce temporary reduction in intracranial tension. Syringomyelia is often treated by X-rays, but the value of this method is doubtful. Intracranial angiomas respond well to X-ray therapy, but they require repeated treatment over several years. Of cerebral tumours medulloblastomas are the most radio-sensitive and should always be submitted to X-ray treatment. Since they tend to spread in the central nervous system, the whole of the system should be irradiated, section by section. Good results may be obtained in any type of cerebral tumour, and this therefore justifies a trial of radiotherapy in most cases.

Ductless glands

X-ray therapy has an important place in the treatment of hyperthyroidism, good results being obtained especially in the cases occurring about the age of puberty and the menopause. Compared with operation, X-ray therapy has the disadvantage that the treatment must be applied weekly for two to three months, and recovery is much slower than after thyroidectomy. Carcinoma of the thyroid gland is usually radio-sensitive, and good results are sometimes obtained from deep X-ray therapy even in inoperable cases. Operative treatment of carcinoma of the thyroid should always be followed by prophylactic X-ray exposures.

Pituitary

The eosinophil adenomas of the anterior pituitary respond better than the chromophobe type. The progress of acromegaly can often be arrested, and sometimes regression is even seen in the typical appearances associated with this disease.

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RAT-BITE FEVER

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1.–DEFINITION

(*Synonyms.*—Rat-bite disease; sodoku; sokosho)

1344.] This is a relapsing fever which follows the bite of rats and is due to an infection with *Spirillum minus*, which occurs naturally in these animals. A similar disease resulting from the bite of cats, weasels, monkeys, or other animals has been described.

2.–AETIOLOGY

Geographical distribution

Rat-bite fever is world-wide in its distribution, and cases have been recorded in almost every country. The first cases were reported from Japan, where the incidence is very high: the disease is also prevalent in Calcutta, and in India generally; during the period 1931–8 no less than 279 authentic cases have been reported from Calcutta alone.

Causal organism

The causal organism, *Spirillum minus*, was first seen by Vandyke Carter (1887) in the blood of rats in India. Futaki, Takaki, Taniguchi, and Osumi (1916) were the first to discover the parasite in man. These workers saw the organism first in the fluid obtained by puncture of inflamed lymphatic glands, but later in the blood, and named it *Spirochaeta morsus muris*—a name which is still retained in some text-books. A disease very similar to rat-bite fever, due to an organism morphologically identical with *Spirillum minus*, has been described as following the bite of cats by Yamada, Mooser, and others.

3.–BACTERIOLOGY AND MORBID ANATOMY

The organism *Spirillum minus* is a comparatively broad spiral measuring generally about 2 to 5μ but occasionally up to 9 or 10μ. The coils are very regular and vary in number with the length of the body. In the short forms there may be only one and a half to two turns, whereas in the longer forms there may be seven or eight coils. Some workers state that the long forms are specially seen in the fluid from the inflamed lymphatic glands, and the short forms in the blood; but I have seen both short and long forms in the blood of infected animals. *Under dark-ground illumination* Seen under dark-ground illumination, the spirillum is exceedingly active and has a perfectly rigid body. Movement is accomplished by a group of flagella at each end. Row, who first discovered the spirillum in an Indian patient, claimed that the Indian strain was definitely smaller than the Japanese, and that it had no terminal flagella; but from the work of Parmanand, who demonstrated the flagella, there appears to be no difference between the Indian strain and the type found elsewhere. The progression is usually backwards or forwards in a straight line and is sharp and darting. *Division* Multiplication takes place by transverse fission at the middle line of the body.

Classification of organism At first this organism was classified with spirochaetes, but, as Zuelzer pointed out, it is more like a spirillum with rigid body and terminal flagella and, unlike a spirochaete, stains readily with ordinary dyes. There is very little doubt that the organism which occurs in the human disease is identical with the spirillum originally described by Carter from an Indian rat. In this event the correct name for the organism would be *Spirillum minus* Carter, 1887.

Transmission to animals The spirillum is readily inoculable to mice, guinea-pigs, rats, and monkeys. Levaditi and his colleagues have shown that *Spirillum minus* in white mice can be transmitted from the mother to the young either *in utero* or through the infected milk.

Cultivation of organism Futaki, Takaki, Taniguchi, and Osumi stated that they had obtained a culture of the organism.

Sodium nucleate, 0·5 to 0·75 gram, is dissolved by shaking in 100 c.c. of horse-serum, and a current of anhydrous carbon dioxide is passed through for three or four minutes till the solution is transparent. The tubes are heated to 60° C. for an hour on three consecutive days and to 65° C. for half an hour on the fourth day. The medium is now ready for use. After inoculation the tubes are kept at 37° C. for two weeks, when as many as ten spirilla may be found in each microscope field. Forms up to 19μ long were seen in the cultures. Knowles and Das Gupta repeated the technique, using goat-serum in place of horse-serum, but were completely unsuccessful.

Joekes found the following technique successful: to a tube containing a slope of Loeffler's inspissated horse-serum are added 10 c.c. of a mixture of peptone 1 gram, N/1 phosphoric acid 3 c.c., and distilled water 900 c.c. (*p*H 7·2). After inoculation the tubes are incubated at 37° C., when growth occurs, and subcultures may be made either on the same medium or in 1 per cent glucose broth. A most curious feature of Joekes's culture was that all successful cultures contained a symbiotic coliform bacillus, from which he failed to separate the spirillum. Joekes's success has not been confirmed by any subsequent worker.

Associated streptothrix infections

Blake isolated a streptothrix from rat-bite fever cases in America, named the organism *Streptothrix muris ratti*, and claimed that it was the cause of the disease.

In this connexion a finding by Knowles and Das Gupta is interesting. A patient was admitted to the Carmichael Hospital for Tropical Diseases in Calcutta suffering from rat-bite fever, and a white mouse was inoculated with his blood. A fortnight later *Sp. minus* was present in the blood of the mouse, but a streptothrix was also present. On sub-passage into a second mouse the *Sp. minus* infection 'took', but not the streptothrix.

Secondary streptothrix infections are not uncommon in ulcerative lesions of any type in the tropics; it is therefore clear that secondary infection with a streptothrix may occur in cases of rat-bite fever, but without any aetiological connexion with the disease.

Morbid anatomy

The skin around the site of the bite shows hyperaemia, oedema, and polymorphonuclear infiltration into the corium and subcutaneous tissue. The lymph glands draining the region of the lesion become enlarged and show hyperplasia of the parenchymatous cells. In the kidneys marked hyperaemia, swelling, and degeneration of the tubular epithelium have been observed. There are degeneration, necrosis, and destruction of the liver-cells, particularly in the centre of the lobule, with hyperaemia, fatty degeneration, and haemorrhages in the periphery of the lobule. The spirilla have been demonstrated in the liver, spleen, kidneys, adrenals, the oedematous area around the site of the bite, and the enlarged lymph glands.

Blood picture

There is a degree of anaemia proportional to the severity and duration of the disease. In protracted cases counts of the red cells as low as 1,390,000 per c.mm. have been recorded. A moderate leucocytosis (12,000 to 20,000 per c.mm.) may be found at the onset of the fever and is maintained during the febrile period. According to Kuipers and Ruys there is leucocytosis with relative lymphopenia and an eosinophilia during the attacks. There is a rise in the number of eosinophils a few days before the attacks, and during convalescence there is a definite eosinophilia. It is stated that most cases of rat-bite fever give a positive Wassermann reaction. Knowles and Das Gupta tested this reaction in seven cases. It was completely negative in five, doubtful in one, and weakly positive in another. In the last two cases the possibility of previous infection with syphilis could not be altogether ruled out. Sometimes albumin and, more rarely, casts appear in the urine.

Wassermann reaction

Urine

4.—CLINICAL PICTURE

Incubation period and onset

Usually the bite heals within a few days. The incubation period varies considerably from three days to several months; the average, however, is from two to three weeks. The onset is usually sudden and is ushered in by a chill, during which the temperature rises. There is headache of varying degree of severity. Pain in the joints and muscles, especially of the legs and arms, is common. The original wound heals cleanly, unless there is a superimposed septic infection which sometimes masks a true rat-bite fever.

Febrile stage About the period when the febrile symptoms appear, the scar and the tissues around it become indurated and swollen. There is inflammation of the regional lymphatics, and the glands become swollen and tender. Each relapse is usually accompanied by local signs of inflammation at the original wound.

Fever and eruption The temperature usually varies from 102° to 104° F. and sometimes may reach 105° F. A maculo-papular eruption of peculiar purplish shade appears on the extremities, face, and trunk, sometimes even affecting the mucous membranes. It is painless and does not itch. The rash appears synchronously with the febrile paroxysms and fades with the fall of temperature; it may appear with any or all bouts of fever.

Other symptoms Diarrhoea is seldom present. Symptoms referable to the nervous system are nearly always present. Headache, giddiness, and tinnitus are all common during the febrile attacks. The pains in the muscles and joints are very frequent. Paraesthesias and hyperaesthesias are common. Photophobia and conjunctivitis have been noted.

5.–COURSE AND PROGNOSIS

The fever lasts from two to three days, after which there is a sudden fall to normal by crisis (see Fig. 38), often accompanied with profuse sweating. There then follows an afebrile interval of about three to six days, during which both local and constitutional symptoms usually subside. The afebrile interval is suddenly terminated by another paroxysm, during which the local and constitutional symptoms recur. The number of febrile attacks varies in different individuals and probably depends on the degree of resistance of the host. In most cases the paroxysms gradually subside, each subsequent attack of fever being milder than the preceding one, but cases are on record in which the symptoms were prolonged over several months.

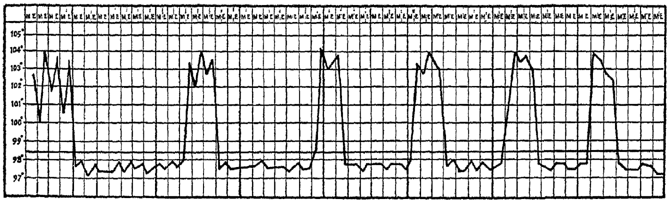


FIG. 38.—Temperature chart in rat-bite fever

Prognosis Since the introduction of specific treatment with arsenical preparations the case mortality has become negligible. If the correct diagnosis is not made, however, the patient may linger in misery for periods up to two years, and the disease may even prove fatal. With proper treatment with the arsenical derivatives the rate of cure is approximately 100 per cent.

6.—DIAGNOSIS AND DIFFERENTIAL DIAGNOSIS

The diagnosis is usually quite straightforward. There is a definite history of bite, usually at night, either by a rat or by some animal that has not been seen. The temperature chart is very characteristic; so also are the local oedema, induration, and pain at the site of the lesion, which is usually healed. Headache, giddiness, usually rigor, and occasionally vomiting accompany the onset of fever. There are acute pains in the limbs. A rash may or may not be present and may easily be overlooked in dark-skinned patients. The lymphadenitis is usually severe and generally affects the glands draining the site of the bite, although occasionally it may be generalized.

(1)—Laboratory Diagnosis

The following procedures may help to confirm the diagnosis:

Examination of local lesions for the organism

Examination for organism with dark-ground illumination

A prick is made with a sharp stout needle into the oedematous area around the site of the bite, and the fluid that oozes out is examined under dark-ground illumination. The spirillum is at first extremely active; it flashes across the field like a streak of light. After the preparation has been put up for some little time, however, the movements slow down, and the spirilla become clearly visible. The preparation should therefore be vaselined and allowed to settle for some time before it is examined.

Stained films

In the absence of dark-ground illumination, films may be stained for diagnostic purposes by either Leishman's or Giemsa's stain. The best method of demonstrating *Spirillum minus*, however, and the one which, in my experience, brings out the terminal flagella best is Tribondeau's modification of Fontana's stain. The details of this method are as follows: (i) A thin film of the clear serous exudate is prepared from the lesion on a clean slide and allowed to dry in the air. (ii) The slide is then laid on a staining-rack and flooded with Ruge's solution, which has the following composition: glacial acetic acid, 1 c.c.; solution of formaldehyde, 2 c.c.; and distilled water, 100 c.c. The fixative is poured on and drained off; this is repeated two or three times for about a minute. (iii) The fixative is drained off the slide, which is next covered with methyl alcohol and flamed by applying a lighted match. This completes fixation.

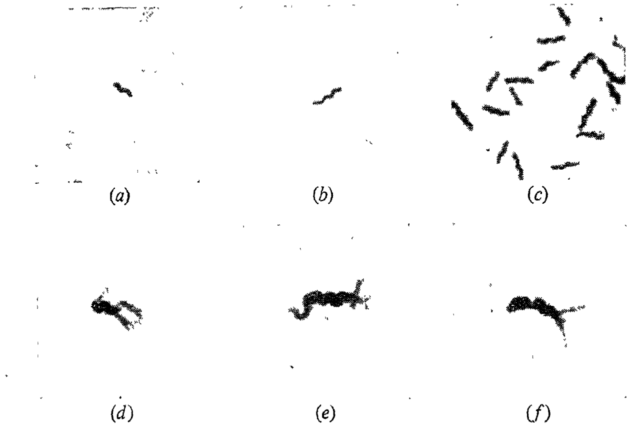
Tribondeau's method: fixation

Mordant

(iv) The slide is laid on the staining-rack and flooded with the following mordant: tannic acid, 5 grams, in distilled water, 100 c.c. It is gently warmed till steam rises. The best and least messy way of doing this is to wrap a little cotton-wool round the end of a piece of wire; this is soaked in alcohol, lighted, and held under the slide. When steam rises from the slide, the flame is removed and the mordant allowed to act for thirty seconds longer without further heating.

Stain

(v) The slide is washed with distilled water and then covered with Fontana's silver solution. To prepare this, a 5 per cent aqueous solution of silver nitrate is taken in a glass cylinder which has previously been thoroughly washed with distilled water. With a capillary pipette strong solution of ammonia is added drop by drop. A sepia precipitate forms and then re-dissolves. To the now clear solution more silver nitrate solution is added very carefully, and only drop by drop, from a capillary pipette, until a solution results which is just opalescent (and not more) on shaking. Not a drop more of the silver solution should be added than is necessary to produce slight opalescence. The slide is covered with the solution and warmed gently till steam rises; then the flame is removed, and the warm solution is allowed to act for a further thirty seconds.



(*a*) (*b*) (*c*)

(*d*) (*e*) (*f*)

FIG. 39.—*Spirillum minus* of rat-bite fever. Photomicrograph × 1800. (*a*) and (*b*) Blood films of an infected mouse (Giemsa). (*c*) Smear of peritoneal fluid of the same animal (Giemsa); the spirilla are much more abundant in the peritoneal fluid than in the blood. (*d*), (*e*), and (*f*) Spirilla stained with Tribondeau's modification of Fontana's stain to show the flagella; (*f*) a dividing form. Owing to the deposition of silver the spirilla appear much thicker than in preparations stained by Romanowsky stains

Drying

(vi) The film is washed in distilled water and allowed to dry in the air. It should never be blotted.

The film is then examined with an oil-immersion lens. The spirilla are stained an intense brown-black or black against a faint yellow background (see Fig. 39).

The spirilla in a film from the serous exudate are usually scanty, and prolonged search may have to be made.

Immobilization test with patient's serum

For this test a guinea-pig or a mouse previously infected with a standard strain of *Spirillum minus* is required.

The patient's serum is diluted 1 in 5 with physiological saline, and one volume of the diluted serum is mixed with an equal volume of the blood of the infected animal on a slide. A coverslip is applied, and the preparation sealed with soft paraffin and allowed to stand for one hour. It is then examined under the dark-ground microscope. It is essential in all cases to put up a control preparation with normal serum from a person who has not been bitten. In the control preparation the spirilla are still actively mobile at the end of an hour, but in the patient's serum, if the result is positive, the spirilla are completely immobile at the end of an hour or sometimes sooner. The test is of value in diagnosis only if the result is positive. A positive result indicates that the patient is infected with *Spirillum minus*.

Inoculation of susceptible animals

As pointed out by Knowles and Das Gupta, this is the most certain and reliable method of demonstrating that the patient is infected with *Spirillum minus*. The most susceptible animals in order of frequency are: (i) white mice; unfortunately the white mouse is itself liable to spontaneous infection with *Spirillum minus*, but if the blood and the peritoneal fluid (especially the latter) of the mouse prove negative on a preliminary examination, the animal may be considered suitable for the diagnostic test; (ii) young guinea-pigs; and (iii) white rats and adult guinea-pigs. Rabbits and monkeys have also been found susceptible.

The animals can either be inoculated subcutaneously with a drop of serous exudate from the lesion or intraperitoneally with the patient's blood. The technique for the latter operation is as follows:

Technique of test

At a time when the patient has fever, 2 c.c. of blood are withdrawn from the median basilic vein with a hypodermic syringe and immediately inoculated into two animals, 1 c.c. being given intraperitoneally to a young guinea-pig and 0·5 c.c. intraperitoneally to a white mouse. The blood and peritoneal fluid of these animals are then examined daily from the sixth day onwards under the dark-ground microscope. A small drop of blood is obtained either by snipping off the end of the tail of the mouse or snipping the nail of the guinea-pig with a fine sharp pair of scissors, or by puncturing a marginal vein of the guinea-pig's ear with a hypodermic needle. To obtain the peritoneal fluid the abdominal wall is punctured with a very fine capillary pipette, and a small drop of fluid is withdrawn by suction. The blood or the peritoneal fluid is placed on a thin perfectly clean slide, which should not be more than 1·2 mm. thick. A very thin and scrupulously clean coverslip is then dropped on it, and soft paraffin is applied. It should be examined under dark-ground illumination about half an hour after it has been made, by which time the spirilla have slowed down to some extent, and their detection becomes easier.

Identification of organisms in test animals

It is very important not to mistake pseudo-spirochaetes, i.e. filaments from disintegrating red corpuscles, and blood-platelets for sluggish spirilla. In the absence of the dark ground, blood films can be taken from the inoculated animals and stained with Fontana's stain or with Leishman's or Giemsa's stain. The spirilla as a rule are not numerous in the film and may have to be searched for some little time before they are found. Once it has been seen, however, the laboratory worker can never fail to identify *Spirillum minus* again. With Fontana's stain it shows up very prominently, the deposit of silver causing it to appear thicker and coarser than it really is, and the terminal flagella usually stain well by this method.

(2)—Differential Diagnosis

Although the diagnosis of rat-bite fever is usually straightforward, yet in my experience it may occasionally present unexpected difficulties.

Diagnosis from sepsis following rat-bite

The simple septic fever due to a rat-bite is accompanied by suppuration at the site of the wound, marked polymorphonuclear leucocytosis (to a much greater degree than in true rat-bite fever), and an entirely different temperature chart. Sometimes, however, septic infection may be superimposed on true rat-bite fever; hence the presence of sepsis and an aberrant temperature chart do not necessarily exclude infection with *Spirillum minus.*

From filariasis and filarial lymphangitis

Rat-bite fever may perhaps be diagnosed as filarial fever and the acute swelling and oedema at the site of the bite as filarial lymphangitis. The bite may have been forgotten or may have been so trivial as to have been overlooked. Examination of blood withdrawn at night will usually disclose microfilariae in filarial fever, but in established filarial lymphangitis microfilariae are often not found.

From relapsing fever

In areas where rat-bite fever is prevalent together with relapsing fever confusion may arise. The febrile period in rat-bite fever, however, rarely exceeds forty-eight hours, whereas in relapsing fever it is usually five or six days. Examination of a fresh drop of blood taken from the patient during the febrile phase usually fails to show any spirilla in cases of rat-bite fever, whereas *Treponema recurrentis* are usually very numerous in relapsing fever.

From malaria

The onset of fever with acute malaise, headache, joint pains, and sometimes vomiting, and the defervescence with sweating may simulate malaria. Differentiation is readily established by examining a stained blood film, but the two diseases may co-exist.

From dengue

It is possible that rat-bite fever may be mistaken for dengue during a dengue epidemic. The local lesion in rat-bite fever and the entirely different temperature charts in the two diseases should establish the differential diagnosis.

From erysipelas

The acutely painful brawny red oedema at the site of the bite in rat-bite fever somewhat resembles the local condition present in erysipelas. On the other hand, in rat-bite fever there is no defined advancing margin to the area of acute inflammation. The leucocytosis is much greater in erysipelas, and the temperature chart does not show the periodic relapses of rat-bite fever.

7.–TREATMENT

Preventive

In an area where rat-bite fever is prevalent people should sleep in rat-proof houses, and efficient measures should be employed to destroy rats. If a person is bitten by a rat, the wound should be disinfected with pure liquefied phenol.

Specific

The treatment of rat-bite fever is simple. The arsphenamine compounds are specific. Two intravenous injections of neoarsphenamine of 0·3 and 0·45 gram are usually sufficient to effect a cure, but it is advisable to give a third injection of 0·6 gram in order to make sure that the infection has been eradicated. In patients whose veins are not prominent intramuscular injections of solu-salvarsan may be employed with equal success. Generally three injections of 3 c.c., 4 c.c., and 5 c.c. are required for a course. When there is much albumin in the urine, it is advisable to trust to repeated injections of small doses rather than to two or three larger doses.

The local inflammation and pain may call for hot fomentations, but with the destruction of spirilla by arsenical injections the local symptoms clear up almost as rapidly as the fever.

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RAY FUNGUS

See ACTINOMYCOSIS, Vol. I, p. 173

RAYNAUD'S PHENOMENON

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Reference may also be made to the following titles:

ARTERIAL DISEASE AND DEGENERATION
SCLERODERMIA
SYMPATHETIC AND PARASYMPATHETIC NERVOUS SYSTEM DISEASES

1.–DEFINITION

1345.] 'Raynaud's phenomenon' may be defined as attacks of pallor or cyanosis of the extremities brought on by cold. It is a syndrome which is found in many diseases.

As this phenomenon is *intermittent* the hands and feet are usually of a normal colour for the greater part of each day, the pulses are normal in volume, and nutritional changes if present are limited to the skin.

History In his thesis for the Paris doctorate (1862) Maurice Raynaud described seven different conditions in which he had found this phenomenon. Subsequent authors did not appreciate fully the number of diseases which Raynaud had seen, and the medical literature of the next sixty years contained many varied descriptions of 'Raynaud's disease'—a term which came into use as a convenient clinical label for obscure cases in which cyanosis or gangrene happened to occur. Jonathan Hutchinson (1893) recognized the significance of Raynaud's thesis and first used the term 'Raynaud's phenomenon'. His teaching was largely forgotten; and it was not until the recent work of Lewis and Pickering and of Allen and Brown that the problem was made clearer and the term 'Raynaud's disease' restricted to one small well defined clinical group—one only of the many different diseases in which the symptom-complex of 'Raynaud's phenomenon' occurs.

2.–AETIOLOGY

Raynaud's phenomenon may be found in any of the following conditions: in normal persons exposed to cold long enough to lower the blood temperature; in hereditary cold fingers; in Raynaud's disease; after local injury to the hands or feet and in workmen using vibrating instruments; in sclerodactyly; thrombo-angiitis obliterans; arteriosclerosis; syphilitic arteritis; 'rheumatic' (? streptococcal) arteritis; cervical rib; subacute infective arthritis; and lupus erythematosus. The condition also occurs rarely in leukaemia, erythraemia, malaria, pulmonary tuberculosis, and chronic arsenical poisoning, from pressure of a crutch in the axilla, and after local sepsis in the fingers or toes.

3.–CLINICAL PICTURE

(1)—Symptoms and Signs of Raynaud's Phenomenon Common to All Conditions in which it Occurs

Effect of cooling of hands

The patients complain of attacks of pallor, blueness, or numbness of the fingers brought on by contact of the hands with anything cold. The affected fingers are described as 'feeling cold', 'going white', 'waxy', 'numb', or 'dead'. Keeping the palms of the hands in cold water (15° C.) for fifteen minutes in a cool room (18° C.) is usually sufficient to induce an attack.

Effect of lowered body temperature

Patients say that their body temperature is just as important, if not more so, than that of their hands in determining the onset of cyanosis. When they feel chilly in themselves their hands go blue on the slightest provocation—when sitting in a draught; when walking, cycling or driving a car in cold weather; or when swimming. When their bodies are really warm it is impossible to induce an attack no matter how cold their hands are. Early in the day, when washing, shaving, or eating breakfast, they experience the greatest inconvenience, probably because when getting up in the morning the normal body temperature is about 1° F. lower than in the evening. Sometimes patients say that attacks may be brought on quite suddenly when they first enter a *warm* room after being out in the cold. This apparent anomaly may be explained, I believe, as follows: warmth dilates the superficial vessels, and the extra blood thus flowing from the skin returns to the heart cooler than usual, because the veins through which it must pass lie in subcutaneous tissue which has been chilled to a considerable depth. On entering a warm room, after being cold, the blood temperature may thus continue to fall for some minutes and an attack of Raynaud's phenomenon may be precipitated.

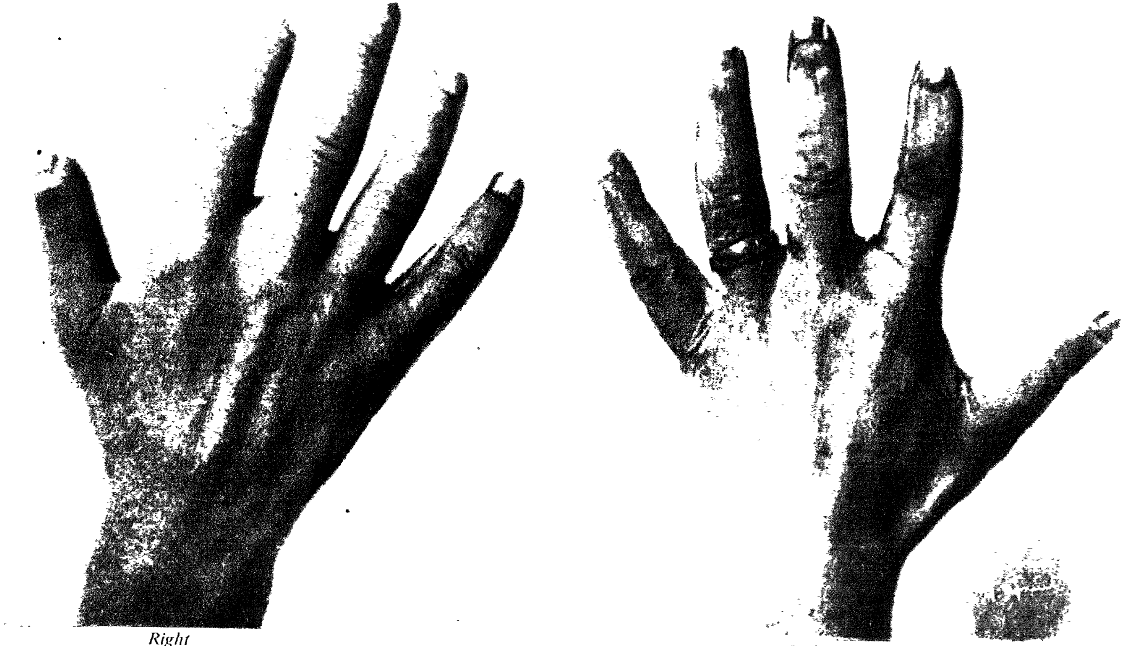
Effect of emotion

Some patients complain that emotion will bring on their attacks. In this connexion it is interesting that an injection of adrenaline may have a similar effect.

Colour changes

The attacks vary from slight pallor of one finger-tip to cyanosis and numbness of all the fingers of both hands. With the hands at rest, below the level of the heart, the fingers at first are blue (see Plate VI). If the hands are lifted or the fingers moved, blood leaves the skin and a yellow-white pallor results. The cyanosis starts as a light-bluish tint ('dusky', 'a pale violet') and later becomes a deeper blue ('slate blue,' 'leaden colour', 'deep purple'). It always starts at the finger-tips and spreads proximally to the base of the fingers, perhaps to the palm; rarely, if ever, does it reach above the wrist. If the attack persists for long, a secondary waxy pallor replaces the cyanosis. The hands remain blue or pale until they are warmed.

When the hands are warmed (40° C. for three minutes), or when the body temperature rises, the blueness begins to pass off and irregular red blotches appear in its midst 'like the spots on a plaice'. Some of



Hands immersed in water at 15° C. for fifteen minutes, after injection of a local anaesthetic (2 per cent novocain) around the right median nerve at the wrist. Left hand is in a typical 'attack'. Right hand shows escape of the fingers whose vessels are supplied by the median nerve. (This and Plate VII from *Quarterly Journal of Medicine*, 1936)

PLATE VI

[*To face p.* 488

these appear and fade away, but in the end they coalesce until the dorsum of the hand and the palm are fiery-red or scarlet. Gradually this redness spreads up each finger from base to tip. All the fingers do not recover at the same rate; some may be red throughout while others remain blue. After an hour or so this bright colour fades, leaving the hand with its natural tint. If body temperature is normal and a hand of one of these patients is placed in water below 10° C. an attack is not produced, and the skin becomes fiery red ('reaction to overcooling'); but if body temperature is low cyanosis may occur.

Sensory changes

Throughout the period of cyanosis the patients complain of a 'tingling' or of a 'feeling of numbness' in the fingers; some of an 'uncomfortable sensation'; some of a 'slight pain'; severe pain is unusual. A marked degree of sensory impairment (hypoaesthesia and hypoalgesia) is found if colour changes have persisted for more than twenty minutes; there is a short latent period between the appearance of cyanosis and the development of this sensory loss. When warmth is applied in any form —hot air in front of a fire, or by friction—the fingers quickly recover their normal colour. During recovery many patients complain of 'pins and needles', 'tingling like nettles', a 'fiery hot throbbing', or just 'discomfort'.

Temperature changes

Patients say that their fingers feel cold during the attacks, and this can be confirmed by an observer touching the skin. An accurate record of the temperature of the finger-tips may be made using special apparatus (thermo-electric couples). The rapidity with which a rise in skin temperature occurs when the tone of the vessels is artificially released is especially valuable in assessing how much of a circulatory defect is due to organic obstruction in the lumen of the arteries and how much is due to muscular contraction in their walls. In this way an accurate forecast may be made of the benefit which is likely to follow paralysis of the vasoconstrictor nerves by sympathectomy. This release of vasomotor tone is usually achieved by raising body temperature (in a heat cabinet, a hot bath, or by T.A.B. injections) or by paralysing temporarily the vasoconstrictor nerves by peripheral local anaesthesia (of the median—Plate VI—ulnar, or posterior tibial nerves), by paravertebral block of the sympathetic ganglia or, for the lower limbs, by spinal anaesthesia.

Other changes

In only a few patients is sweating of the hands a marked feature during attacks. Swelling of the fingers is rare. In a severe attack local pressure on a finger leaves an indentation which takes longer to disappear than when the circulation is normal. While the hands remain cold the radial pulses are of smaller volume, and the veins less prominent, than when the hands are warm. If a finger is accidentally cut when cold it does not bleed, 'only a little dark blood oozes out'.

Symptoms in feet

When patients complain of symptoms in their feet these are usually less severe than in the hands.

(2)—Special Characteristics of the Different Conditions in which Raynaud's Phenomenon Occurs

(a) *In Normal Persons when Body Temperature Falls*

In the majority of healthy persons Raynaud's phenomenon cannot be produced by exposure to cold so long as the blood temperature remains normal. When this falls, however, Raynaud's phenomenon may appear, and the extent of the fall necessary to produce it varies in different individuals. In several experiments on myself in a cold bath it was found that the first signs of Raynaud's phenomenon developed when the blood temperature had fallen to 95° F., but it was not marked until 94° F. was reached; by that time I was shivering violently and might be said to be 'blue and numb with cold'.

Body temperature fell in another experiment on myself, in cold air, when heat-loss from the skin of the trunk had been increased by an erythema following exposure to ultra-violet rays. On this occasion also typical Raynaud's phenomenon developed in the hands and feet, although the skin of the rest of the body felt glowing with warmth.

(b) *In Hereditary Cold Fingers*

Many healthy young people find that one or more of their fingers go white and numb when bathing, when driving a car, or on particularly cold days. This is the commonest type of Raynaud's phenomenon, and Raynaud himself gave an excellent description of it, ending up with the sentence: 'This state, which I dare hardly call a disease, is local syncope in its simplest form'.

Onset in childhood in males and females

It is probable that the mechanism by which symptoms are produced is the same as in the previously mentioned group, except that only a slight fall in body temperature is needed to precipitate an attack. The syndrome is so common that every medical practitioner must have seen many cases. The onset is usually during childhood, often about the eighth year. Both sexes are affected, males as often as females. Members of the patient's family may also suffer from 'poor circulation'. These three points—age of onset, sex incidence, and family history—differentiate these patients clearly from those with Raynaud's disease, in which the average age of onset is thirty, males are very rarely affected, and a family history of similar trouble is unusual.

The symptoms and signs of the attack are typical of Raynaud's phenomenon, the commonest finding being pallor or slight cyanosis of one or two fingers of each hand, often but not always symmetrical. Between attacks the fingers present no marked nutritional changes, but 'chaps' or cracks at the finger-tips may cause acute discomfort during cold weather. Whitlows do not appear more frequently than in normal persons, and sclerodactyly does not occur. The nose and ears are rarely affected.

Prognosis

When adult life is reached the condition usually remains stationary; sometimes it improves, or it may even disappear; very rarely does it progress to cause serious trouble or to interfere with work.

(c) *In Raynaud's Disease*

There is considerable evidence for the existence of the clinical entity which may be called Raynaud's disease. It is by no means uncommon, even though only one of Raynaud's own patients (case 5) can, I believe, be included under the title. Its diagnosis is never really justified until every other cause of Raynaud's phenomenon has been excluded.

The clinical picture is of Raynaud's phenomenon as it is found in all the groups—attacks of 'dead' fingers brought on by cold—and described in detail on page 488.

Young women affected

The special characteristics of Raynaud's disease itself are that the average age of onset is thirty (nearly always between adolescence and middle age), females are affected almost exclusively, and there is usually no history of similar trouble in the family. Hereditary cold fingers being so common—occurring in some slight degree in 20 per cent of persons—it must sometimes happen that patients who develop Raynaud's disease in early adult life will give a history of having had cold fingers in childhood, or of having relatives with 'poor circulation'. These patients will nearly always describe how their attacks became more severe after adolescence, when the Raynaud's disease developed, a change which does not occur with simple hereditary cold fingers alone. Allen and Brown make a duration of symptoms of at least two years one of their criteria for the diagnosis of this group. The attacks are nearly always symmetrical, another important point in the differential diagnosis.

In my experience of this condition six other clinical points of interest have arisen: (i) it seems to have no definite relation to chilblains or psychoneuroses; (ii) the order in which the colour changes occur (syncope, asphyxia, etc.) is of little or no value in diagnosis; (iii) haemoglobinuria does not occur; (iv) the nose and ears are seldom, if ever, affected; (v) sclerodactyly does not develop (see p. 493); (vi) epilepsy, transient amblyopia, spasm or narrowing of the retinal arteries, dysphasia, or paralyses, if they do occur, are due to something else.

Arteriography in this condition has not yet yielded conclusive evidence of diagnostic importance.

Prognosis

Without treatment many of these patients become steadily worse; some remain stationary. Only a few improve under medical treatment. Sympathectomy helps nearly all. (See p. 498.)

Differential diagnosis

Raynaud's disease may be diagnosed from hereditary cold fingers by the age of onset, the sex incidence, and the absence of a family history of cold hands. It differs from sclerodactyly by the rarity of severe pain, sores on the finger-tips, deformities of the nails, and whitlows, and by the absence of stiffness of the skin of the hands and face. In thromboangiitis obliterans young men are affected and the feet suffer first. Arteriosclerosis usually affects older persons. In syphilitic arteritis the blood Wassermann test may be positive. In 'rheumatic' (? streptococcal) arteritis there is a recent history of sore throat or acute rheumatism. A cervical rib may be revealed by an X-ray. In subacute infective arthritis the small joints of the fingers may be painful or deformed. In lupus erythematosus with Raynaud's phenomenon typical skin lesions are usually present on the hands.

(*d*) *After Local Injury to Hands or Feet and in Workmen using Vibrating Instruments*

Local injury to hands or feet

It sometimes happens that after trauma, such as a bruise from a fives ball, a crushing accident, or after an operation on a finger, signs of Raynaud's phenomenon develop in that single digit. The symptoms may appear almost at once, or perhaps only after several years when arteriosclerotic changes in the damaged artery are superadded. The inconvenience is slight and the patients seldom complain.

Use of vibrating instruments

In this same group may be placed those cases of Raynaud's phenomenon occurring in workmen using vibrating instruments: pneumatic chisels, hammers, riveters, road-drills, and also the pounding and lasting machines used by shoemakers. Whatever instrument is used it seems that the hand which holds the vibrating end is the first to be affected, and the finger which suffers most is that which receives the most vibration. The nature of the material being worked plays a large part in determining the severity of the symptoms; hot rivets are softer to work than are cold rivets and it is found that hot-riveting gives rise to trouble far less often than does cold-riveting.

As in all other causes of Raynaud's phenomenon cold is the precipitating factor; the workmen complain of colour changes or numbness of their fingers, at first only in the mornings when they are dressing, but later at any time of day whenever their bodies or hands are cold. Vibration, though it appears to be the underlying cause, plays no part in precipitating the attacks; colour changes in the fingers seldom occur while the men are at work, except on particularly cold days or when cold air from the exhaust blows over their hands and bodies. Nutritional changes in the finger-tips do not occur in men under fifty; but after this age, presumably owing to superadded arteriosclerosis, they have occasionally been described. Attacks do not occur in the feet, nose, or ears, recurring whitlows are unusual, and sclerodactyly is not found. Callosities over the fingers and palms from the rub of the instrument are common, and a rare finding is local atrophy of the muscles of the thenar and hypothenar eminences.

Bony changes

An X-ray of the bones of the hands and wrists often reveals small punched-out areas of decalcification in the carpal bones and in the heads of the metacarpals. Osteoarthritis of the elbow and shoulder joints sometimes occurs.

Prognosis

When these men stop or change their work the symptoms may improve, but do not usually disappear; the residual circulatory defect causes considerable discomfort in many cases.

(*e*) *In Sclerodactyly* (*Acrosclerosis*)

Age of onset The onset of symptoms is usually around the age of thirty, nearly always between adolescence and middle age. Females are affected far more frequently than males, the proportion being about nine to one. *Sex incidence* The first symptom of which these patients complain may be either Raynaud's phenomenon or stiffness of the fingers, and either of these conditions may cause considerable discomfort for some months or even years before the other shows itself.

Four clinical points help to distinguish this group from other conditions associated with Raynaud's phenomenon:

Pain (i) Severe pain is common; in one-third of these patients it is by far the most troublesome symptom, not only during the cyanosis, but also in the recovery stages.

Stiffness of fingers (ii) Stiffness of the fingers is nearly always symmetrical and may cause considerable inconvenience. In some cases it may not appear for three years or more after the onset of vasospastic attacks. In its early stages the thickening of the skin may be very difficult to recognize, especially when confined to the distal phalanges, and at this time the differential diagnosis from Raynaud's disease may be difficult. Sometimes it is only when movements of full flexion or extension of the fingers are impaired that the condition can be diagnosed with certainty. By then the skin, especially over the distal phalanges, looks stretched, tense, and shiny, and its natural creases have disappeared; it is thickened, and difficult to pinch up from the underlying tissues. The finger-tips may look waxy-white; the fingers may be tapering and the joints appear a little swollen. In a later stage movement is seriously interfered with, full extension of the hand is impaired, and several centimetres may separate the surface of the palm from the pads of the fully flexed fingers. Patients in whom sclerodactyly is preceded by Raynaud's phenomenon are, I believe, in a clinical group distinct from those with Raynaud's disease, in whom vasospastic attacks persist for very many years without a trace of thickening in the skin of the fingers.

Sores on finger-tips (iii) Nutritional changes in the finger-tips are found in 75 per cent of these patients and may be of four types, which often occur together. (*a*) Small sores may appear at the finger-tips, sometimes on the knuckles, produced by a patch of superficial gangrene from which a flake of skin dries up and peels off. These sores are not associated with suppuration unless secondary infection occurs. Before the sore develops, a blister, a blood blister, a black spot, or sometimes a crack in the skin is not uncommon. These sores are often very painful; they may take months to heal, and they leave small depressed scars which are sometimes star-shaped and may be tender. *Deformities of nails* (*b*) The nails may become short, dull, brittle, and cracked, sometimes with transverse ridges and sometimes with their edges turned up. The nails may even be lost. Gross deformity of a single nail is usually evidence of a previous whitlow. *Shortening of phalanges* (*c*) In many cases the distal phalanges are shortened, making the fingers look peculiarly stumpy. An X-ray of these fingers reveals atrophy and absorption of the terminal phalanges, and occasionally calcified nodules under the skin—hypodermolithiasis (calcium gout). (*d*) Whitlows are a serious trouble in about one-fifth of the patients, and may take many months to subside. Sometimes they are very severe and require frequent operation for removal of sequestra.

Whitlows

Sclerodermia of face

(iv) Sclerodermia may occur elsewhere on the body. The skin of the face is affected in about three-quarters of these patients and the change is easily recognized. The face has a fixed, pinched, mask-like expression; the skin is tense, smooth, glossy, and 'waxy', especially round the eyes and mouth. Such skin feels indurated and can be picked up with difficulty, if at all, off the forehead and malar regions. The nose may be thin, the mouth small and only with difficulty opened wide, and the teeth may protrude. Attacks of discoloration of the nose and ears are rare, and sores on these parts rarer still. The skin of the neck, arms, trunk, and legs may perhaps be affected, and pigmentation and small telangiectases are often present on or around the thickened skin. Only half of these patients complain of attacks of pallor, cyanosis or stiffness of their feet; in only a very few do superficial sores develop on the toes.

Progressive nature

The majority of patients in this group become steadily worse. In a few the condition remains stationary. After some years the majority find that fine work with the fingers is difficult; others are forced to give up their work altogether. In later stages the fingers become very stiff, attacks of cyanosis become more frequent and more severe until the extremities are permanently cold and blue and the definition of Raynaud's phenomenon is no longer satisfied. When diffuse sclerosis occurs in the skin of the whole body it is a terrible and crippling affliction.

(*f*) *In Thrombo-Angiitis Obliterans*

Age and sex incidence

One-third of patients with this disease, in its early stages, exhibit vasomotor symptoms and signs which fulfil all the criteria of Raynaud's phenomenon. The condition is almost confined to males who are cigarette smokers, and the legs are nearly always more affected than the arms—two very important points in diagnosis. (See Vol. II, p. 46.)

The age of onset is usually around forty. One leg is often affected before the other; but, in the end, the condition is generally bilateral and the hands may be involved. Observant patients may notice the vasospastic stage, as an intermittent pallor or cyanosis of their feet or hands, for several months before the onset of claudication or 'rest-pain'.

Progressive nature

The stage showing Raynaud's phenomenon may last a few months, or perhaps a year, before being replaced by permanent cyanosis of the extremities.

(*g*) *In Arteriosclerosis*

In old age

After the age of fifty, in both males and females spasmodic cyanosis of the fingers or toes occurs more frequently than was at one time thought. These attacks of cyanosis in the early stages of arteriosclerosis often satisfy all the criteria of Raynaud's phenomenon; they may recur for several years and cause old patients considerable discomfort. The feet are usually affected more severely than the hands. With an ophthalmoscope irregularities or spasm may be seen in the retinal arteries. An X-ray of the limbs may reveal calcification in an artery wall and arteriography may show the exact site of obstruction. Arteriosclerosis in young persons is usually associated with chronic nephritis or hypertension, and in older people sometimes with diabetes mellitus. In the later stages, when changes in the vessels are very marked, permanent coldness of the extremities is found.

Retinal changes

Radiographic findings

(*h*) *In Syphilitic Arteritis*

Congenitally syphilitic infants, and young or middle-aged adults with the acquired disease, may sometimes, though rarely, exhibit a typical Raynaud's phenomenon. Two interesting points arise in connexion with this. In a recent critical review (1936, a), and in my own patients, I have been impressed by the fact that there is a definite or a very suggestive history of syphilis in every case of so-called 'Raynaud's disease' showing severe necrosis of the nose and ears, and also in every case with haemoglobinuria. The former is not generally recognized, but the association between syphilis and haemoglobinuria is well known.

Necrosis of ears and nose

Haemoglobinuria

It may be taken as a working rule that whenever Raynaud's phenomenon is associated with severe necrosis of the ears or nose, or with haemoglobinuria, it is most probably due to syphilitic endarteritis. Just as in arteriosclerosis, with which syphilitic arteritis is often associated, a continuous cyanosis of the extremities later replaces the intermittent attacks.

(*i*) *In 'Rheumatic' (? Streptococcal) Arteritis*

Acute rheumatic infections are sometimes associated with Raynaud's phenomenon. The patient may have suffered previously from sore throat, acute rheumatism, carditis, or chorea, and then ten days to three weeks after another sore throat the fingers or toes become blue and numb whenever they are exposed to cold. Rapidly this may become more severe until, in the course of a day or two, the colour changes become continuous. At this stage temperature tests and oscillometric investigations may reveal an almost complete organic obstruction in the peripheral arteries.

Previous rheumatic manifestations

After a week or two improvement usually sets in and Raynaud's phenomenon reappears. This improvement continues and complete recovery may occur, but more usually the intermittent colour changes persist in some slight degree. Nutritional changes—such as superficial sores at the finger-tips and whitlows—may appear from time to time, and if the rheumatic manifestations should recur (e.g. sore throats, arthritis) the vascular symptoms become worse with each attack.

(*j*) *In Cervical Rib*

A cervical rib may be associated with vascular phenomena, but the colour changes are nearly always continuous and not intermittent (see CERVICAL RIB, Vol. III, p. 80). A very few cases, however, have been described in which true intermittent attacks of cold blue fingers have occurred in patients with cervical ribs. Because of these very few cases it may be a wise precaution to take an X-ray of the neck of all patients exhibiting Raynaud's phenomenon the cause of which is in doubt.

(*k*) *In Subacute Infective Arthritis*

Patients with subacute infective arthritis may be liable to attacks of cold blue fingers and toes during the course of the disease (see Vol. II, p. 77). Sooner or later, as the changes in the joints and wasting of muscles become more marked, Raynaud's phenomenon is replaced by a condition of continuous blueness and coldness of the extremities.

(*l*) *In Lupus Erythematosus*

When lupus erythematosus affects the hands it is often associated with Raynaud's phenomenon. Characteristic lesions—erythema, scaling, and atrophy—appear on the backs of the fingers, hands, or forearms; these patches persist and coalesce, the skin becomes thinned and shiny, and the fingers tapering. This thin skin is easily pinched up from the underlying tissues—an important point in distinguishing the condition from sclerodactyly which it may resemble. Typical lesions of lupus erythematosus may be found on other parts of the body, commonly on the face and scalp (see Vol. VIII, p. 247).

4.–DIFFERENTIAL DIAGNOSIS OF COLD BLUE EXTREMITIES

The first question to be answered is: Is it 'Raynaud's phenomenon'? i.e. Is there *intermittent* cyanosis of the extremities, brought on by cold, with the skin a normal colour between attacks?

The following conditions with their vascular phenomena are eliminated by this simple definition, many of them because their symptoms are continuous and not intermittent: chilblains; frost-bite; acrocyanosis; erythrocyanosis; clubbed fingers and cyanosis of the fingers and toes due to lesions of the heart and lungs; enterogenous cyanosis; incipient gangrene from arterial thrombosis (in advanced arteriosclerosis, thrombo-angiitis obliterans, or ergotism); arterial embolism; diseases of the nervous system (neuritis, poliomyelitis, syringomyelia, pyramidal lesions, and hysterical paralysis).

If the condition *is* true 'Raynaud's phenomenon', then the pathological group to which the patient belongs must be determined. The following simple clinical points are helpful in deciding this.

In childhood, *hereditary cold fingers* is the most probable diagnosis, especially if there is a family history of 'poor circulation'. If the child's nose and ears are affected, or haemoglobinuria occurs, *congenital syphilis* should be diagnosed. *In children*

In young women the onset of Raynaud's phenomenon is likely to be due to *Raynaud's disease.* If pain is severe and the fingers are stiff, with sore places or scars on their tips, then *sclerodactyly* is the probable cause, and sclerodermia of the face should be looked for. A scaly rash on the hands suggests *lupus erythematosus.* *In young women*

In young men in whom the feet are first affected, *thrombo-angiitis obliterans* may be diagnosed, especially if the patient is a heavy smoker, if there is a history of intermittent claudication or 'rest-pain', and the dorsalis pedis arteries are not easily felt. The onset of symptoms after a severe sore throat suggests *rheumatic (? streptococcal) arteritis.* If the hands alone are affected in a man who works with a *vibrating instrument*, his symptoms are almost certainly due to his occupation. In *syphilitic arteritis* the blood Wassermann reaction may be positive. *In young men*

A diagnosis of 'Raynaud's disease' in a man, or of thrombo-angiitis obliterans in a woman, is nearly always wrong.

In old age the onset of attacks of Raynaud's phenomenon suggests *arteriosclerosis*, especially if an X-ray of the limb reveals calcification along the course of the artery. *In old age*

5.–TREATMENT

(1)—Local and General

Cold in any form should be avoided; the temperature of the body as a whole is almost more important than that of the hands and feet, and warm clothing is essential. The temperature of a living room should be about 20° C. (68° F.). Cold water should be banned, and washing up, peeling vegetables, or gardening in cold weather left to others. *Avoidance of cold*

Gloves should be loose, and especially thick around the wrist and over the palms and fingers; they should slip on and off easily with no button or strap to undo; they should also be long and overlap the coat-sleeves so that no bare skin is exposed at the wrist. Many gloves on the market are unsuitable, especially those made of wool with an open mesh, and those with thick fur over the dorsum of the hands with only a thin layer of leather over the palm. For people who work with their fingers, mittens are invaluable; for those who do not need free movement of individual fingers 'paw-gloves' are useful—with all four fingers in one compartment and the thumb in another. Some patients carry a muff, others a small hot-water bottle, and others a petrol, carbon, or electric heater in a handbag or pocket. *Type of gloves*

Cracks at the ends of the fingers may be covered with a collodion preparation or with narrow strips of elastic adhesive plaster. The skin of the fingers may be kept soft by applying, after washing and at night, a grease with a melting point of 40° C. (104° F.), such as white soft *Care of the skin* paraffin. Care should be taken to avoid minor injuries to the fingers and when these occur they should be treated at once.

Footwear

Boots or shoes should be of stout construction allowing plenty of room for the toes, and stockings or socks should be thick and soft; two thin socks often keep a foot warmer than one thick one. Tight suspenders should be avoided. For men, spats may help to keep the ankles warm; for women, who are often unwilling to wear suitable shoes and stockings, soft gaiters with zip-fasteners give additional protection. The soles of boots or shoes should be quite waterproof; many patients say that leather is warmer than rubber; a leather sole with a layer of rubber incorporated is perhaps the best. Bedsocks and hot-water bottles are helpful at night.

Drugs

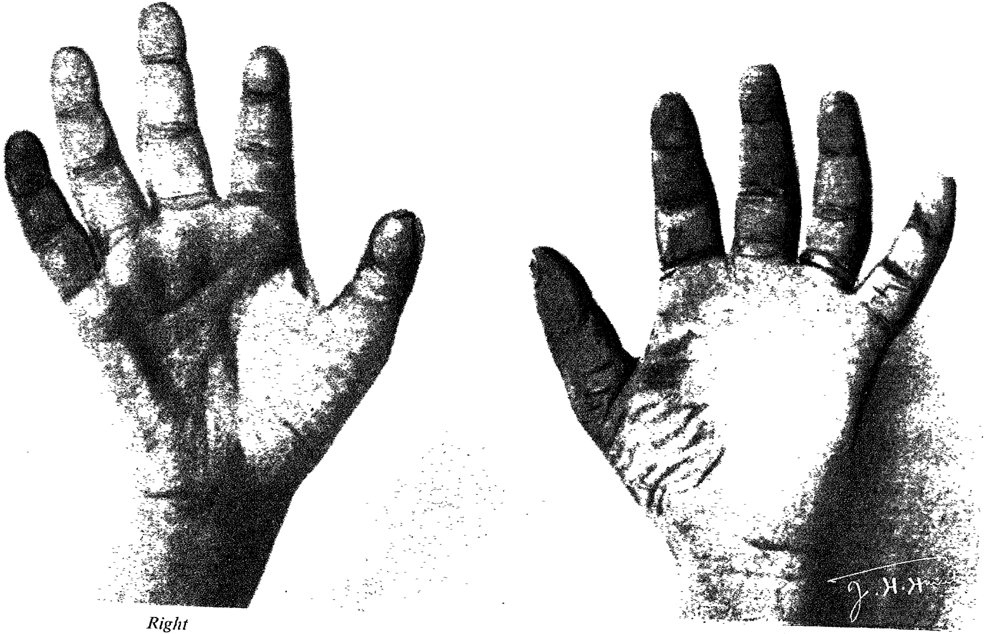
Many drugs have been recommended to relieve symptoms in the more severe cases, their number indicating how few are really valuable. Calcium lactate or gluconate, potassium iodide, and belladonna are perhaps the favourites.

Physical therapy

In some patients physical therapy is needed to give relief: rest in bed with the limb in the position of greatest circulatory efficiency (10 degrees to 15 degrees below the horizontal); postural exercises; radiant heat, taking special care to avoid burns; contrast baths; intermittent venous occlusion; alternating positive and negative pressures; and galvanic baths. (See ELECTROTHERAPY, Vol. IV, p. 493; HEAT, RADIANT, Vol. VI, p. 387; and HYDROTHERAPY, Vol. VI, p. 574.)

Sympathectomy

Whenever Raynaud's phenomenon occurs and whatever be the cause, there must be some degree of muscular contraction in the walls of the arteries or arterioles during attacks. Whether this is the normal vasomotor tone or an abnormal spasm is still *sub judice*, but its removal is followed by an increased circulation to the extremities and on this the operation of sympathectomy is based. The operation of choice for the upper limb is preganglionic section below the third thoracic ganglion, with division of the rami which enter the cord from the second and third thoracic ganglia, and, for the lower limb, lumbar ganglionectomy or excision of the second and third lumbar ganglia with the connecting chain. The necessity for the operation depends on the group to which the patient belongs and the severity of the symptoms. In hereditary cold fingers, after local injuries to the hands and feet, and in workers with vibrating instruments symptoms are seldom, if ever, severe enough to warrant operation; and in syphilitic arteritis adequate medical treatment is sufficient. In the blood diseases, the general symptoms are too serious for any type of operation to be considered. Six conditions remain in which sympathectomy is sometimes indicated, namely, Raynaud's disease, sclerodactyly, thrombo-angiitis obliterans, arteriosclerosis, 'rheumatic' arteritis, and subacute infective arthritis. Of these the result of operation is really satisfactory only in Raynaud's disease, in which it produces relief in every case, although a complete cure is not obtained; in all my patients there has been remarkable symptomatic improvement, but attacks of cyanosis of the fingers can



Right *Left*

Six months after right cervico-thoracic ganglionectomy. Hands immersed in water at 15° C. for fifteen minutes. Left hand is in a typical 'attack', right hand is much less blue than the left

PLATE VII

[*To face p.* 499

still be produced by adequate cooling of the body and hands (see Plate VII). In sclerodactyly, thrombo-angiitis obliterans, arteriosclerosis, 'rheumatic' arteritis, and subacute infective arthritis the results of sympathectomy are less dramatic; improvement may persist for two years or more, but at the end of this time symptoms nearly always return and the patients suffer as before.

(2)—Special

(*a*) *In Raynaud's Disease*

In mild cases it is wise to try medical and physical therapy (see p. 497) for some months before surgery is contemplated. Sympathectomy is indicated when the attacks of cyanosis are causing definite distress or recur so frequently as to interfere with work, and when temperature tests suggest that there is a considerable degree of vasomotor tone.

Sympathectomy

The immediate results of the operation are excellent; but after some months, perhaps two years or more, slight symptoms may return. The patients are then naturally disappointed, but the great majority insist, even several years after the operation, that their hands are better than they were before it. There is not the least doubt that the operation is well worth doing and is followed by beneficial results in almost every case. Patients in whom only one side has been treated will nearly always return for operation on the other side. After bilateral thoracic sympathectomy patients often return for lumbar ganglionectomy, which may relieve them even more than does the operation for their hands.

Results

The relief of major symptoms is due to lifting off the vessels the burden of their normal vasomotor tone, so that a higher threshold of cold is needed to produce an attack. The local fault in the vessels remains untouched, for on this the operation has no effect.

(*b*) *In Workmen Using Vibrating Instruments*

Several methods are being tried for preventing the development of symptoms in these men. (i) The rate of vibration of the instrument may be reduced below the critical level, which seems to be about 2,300 strokes a minute for riveters. (ii) Shock-absorbing pads of porous rubber, perhaps half an inch thick, can be incorporated in the palms of the leather gauntlets which these men wear. (iii) Similar pads may be fixed to the handle of the riveting machine, or a sleeve of the same material fixed around the barrel of the instrument. (iv) It seems that it is only when the men have been at work for two years or more that symptoms develop, so perhaps trouble may most easily be avoided by arranging shifts of work so that no man does the particular job which causes symptoms for more than a few months at a stretch. (v) In some cases it is possible to alter the tool by incorporating a mechanical device, a cylinder containing compressed air, by which vibration is absorbed before reaching the man working the instrument.

Prophylaxis

Once symptoms have developed it is wise for a man to change his employment and carry out the general treatment for Raynaud's pheno-

Change of employment

menon. In spite of this symptoms may persist, but they are seldom severe enough to warrant sympathectomy.

(c) *In Sclerodactyly*

The special treatment for sclerodactyly is described in detail under the title SCLERODERMIA. It includes hot saline baths for the hands and feet, followed by massage with warm olive oil, which may relieve to some extent the stiffness and pain in the fingers and toes. Whitlows should be treated carefully or they may persist for many weeks. The patient must take special precautions to avoid slight injuries to the hands and feet, especially when they are cold and numb. Following trauma ulcers easily develop in the hard smooth skin, especially over the knuckles; if these ulcers become secondarily infected they may take many months to heal.

Indications for sympathectomy

Indications for sympathectomy are: severe pain in the fingers, frequent attacks of cyanosis, increasing deformity, and recurring whitlows. In every case temperature tests should be done in order to estimate the benefit likely to follow operation. If symptoms are severe, and these temperature tests convincing, sympathectomy is well worth while, as some degree of improvement nearly always follows. The skin of the fingers becomes warmer, and perhaps softer and more flexible; pain is relieved; attacks of cyanosis occur less frequently and are less severe; rate of progress in deformity of the fingers is retarded; superficial ulcers heal; the nails grow more normally, and whitlows recur at longer intervals.

End results of operation

The duration of this improvement is often, however, disappointing, and the final results of operation in this group are much inferior to those in Raynaud's disease. After months or years the original symptoms and signs return, even though sympathetic denervation of the limbs can still be proved to be complete. In the legs the results are perhaps a little better than in the arms, but as symptoms in the feet are usually less severe than in the hands lumbar ganglionectomy is more rarely needed.

(d) *In Thrombo-Angiitis Obliterans*

Special treatment is necessary for these patients (see Vol. II, p. 50). Smoking, especially cigarettes, should be cut down to a minimum and excessive walking and all irritation to the feet carefully avoided; precautions against breaking the skin should be taken when cutting the nails, and corns should be pared and not cut deeply.

Results of lumbar ganglionectomy

Most authors agree that the benefit which follows sympathetic lumbar ganglionectomy is considerable in 50 per cent of cases, moderate in 25 per cent, and negligible in the remainder. The operation reduces vascular tone to a minimum and dilates vessels of a collateral circulation.

(e) *In 'Rheumatic' (? Streptococcal) Arteritis*

During the acute stage the patient should remain in bed and be treated as for acute rheumatism. Physical therapy (especially radiant heat) should be given if vascular symptoms are really severe and nutritional changes of the extremities threaten. The patient should not be allowed out of bed until recovery is well advanced.

If the illness is associated with a recurrent acute streptococcal tonsillitis, careful judgement is needed as to the best time for tonsillectomy. If this is done when vascular symptoms are severe or when they are beginning to improve, an exacerbation is likely to follow the operation and more damage result to the arterial walls. It is probably wise to delay operation until all acute symptoms have subsided and the erythrocyte sedimentation rate has returned to normal. Other septic foci should be treated along similar lines.

Tonsillectomy

Sympathectomy is sometimes needed when troublesome vascular symptoms persist.

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RECTUM DISEASES

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Reference may also be made to the following titles:

ANUS DISEASES
COLITIS
COLON, CARCINOMA OF
ENDOSCOPY OF THE RECTUM
LYMPHOPATHIA VENEREUM

1.–INTERNAL HAEMORRHOIDS

Definition

1346.] Internal haemorrhoids or piles are produced by enlargement of the lower ends of the rectal columns of Morgagni, which contain the terminal branches of the superior haemorrhoidal artery. The related internal haemorrhoidal plexus becomes congested, dilated, and enlarged in advancing degrees of internal haemorrhoids.

Three primary internal haemorrhoids are common, in the left lateral, right anterior, and right posterior quadrants (E. W. Miles) (see Fig. 40). Smaller secondary piles occur in the intervals, particularly in the anterior or left anterior, and posterior or left posterior quadrants.

The intero-external type (see Fig. 41) is included in the true internal group.

Aetiology

The numerous aetiological factors may be summarized as follows: (i) Straining at stool: this may be due to chronic constipation or to any form of diarrhoea, such as that caused by purgation, salts taken for slimming purposes, ulcerative colitis, and dysentery. (ii) Straining due to heavy manual work, a chronic cough, prostatic enlargement, or urethral stricture. (iii) Hepatic congestion from habitual alcoholic excess or overeating. (iv) Pelvic conditions obstructing the superior haemorrhoidal veins, e.g. a pregnant uterus, uterine fibroids or retroversion, and ovarian cysts or new growths. (v) The sphincteric relaxation of old age or of any debilitated state, a previous rectal operation, e.g. for fistula, and certain occupations involving prolonged standing. (vi) A hereditary tendency is often present, especially in young subjects.

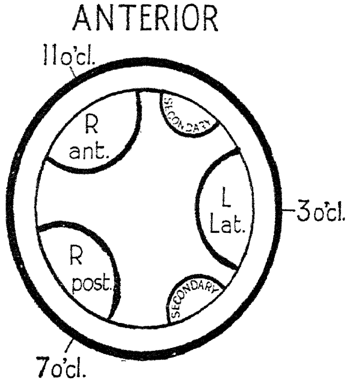


FIG. 40.—Diagram showing usual arrangement of primary and secondary internal haemorrhoids. Rectum viewed from lithotomy position. (This and Figs. 43, 45, 48, 49, 50, and 53, from the author's *The Principles and Practice of Rectal Surgery*)

Morbid anatomy

On section an internal haemorrhoid consists of venous and capillary spaces, with a varying amount of fibrous tissue, covered by a layer of columnar epithelium. Secondary changes are thrombosis, ulceration, or gangrene; thrombosis followed by repair is shown by the conversion of a soft spongy pile into a mass of fibrous tissue.

Clinical picture

First degree

Second degree

Third degree

The chief symptoms are progressive bleeding and prolapse. A first-degree pile bleeds at defaecation but does not tend to prolapse. A second-degree pile bleeds and prolapses a little during defaecation but returns spontaneously into the rectum at the end of defaecation. A third-degree pile remains prolapsed outside the anus and requires digital pressure to reduce it into the rectum (see Fig. 42). Third-degree piles often produce also mucoid leakage and irritation, slight faecal incontinence, and bleeding into the clothing apart from defaecation.

Pain is not prominent but may be produced by thrombosis or by the onset of infection and abscess formation. Acute pain is most likely to be due to an accompanying anal fissure.

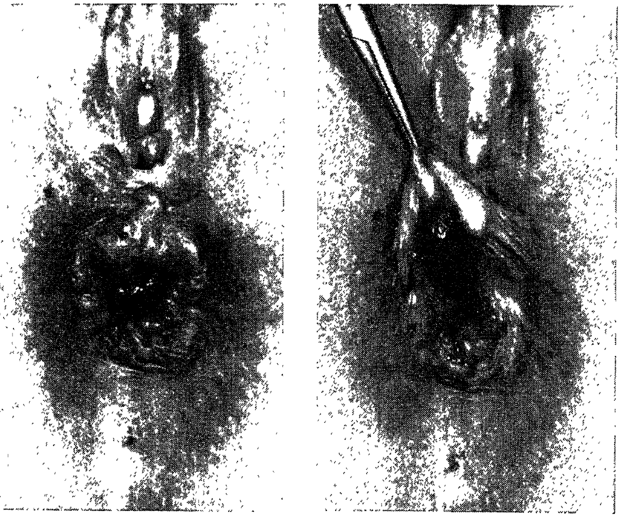

(*a*) (*b*)

FIG. 41.—(*a*) Prolapsed intero-external pile in right anterior quadrant; (*b*) prolapse made evident by traction on related skin tag

General symptoms

The most important general symptom is secondary anaemia from repeated rectal bleeding; lassitude and depression are common. Digital

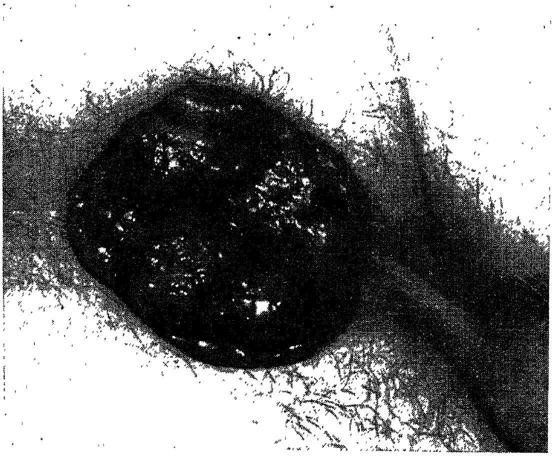


FIG. 42.—Third-degree prolapsed piles

Digital examination

examination may be negative if the piles are small and soft. Large internal piles can often be rolled under the examining finger, and, if there is any fibrosis, or still more if a fibrous polyp has developed, this is readily detected. Sometimes a large pulsating terminal branch of the superior haemorrhoidal artery is palpable in relation to one of the primary piles, and this is generally a clear indication that surgical treatment will be required.

Proctoscopy

The clinical picture of internal haemorrhoids cannot be clearly assessed without proctoscopy. Third-degree piles can be seen in their fully prolapsed state, but in the earlier degrees proctoscopic examination is essential. (For details see ENDOSCOPY OF THE RECTUM, Vol. IV, p. 590.) On withdrawal of the proctoscope the internal piles prolapse into the lumen of the instrument; they are covered with bright pink mucosa, which may be altered by inflammation or ulceration; thrombosis may be evident, or signs of chronic prolapse in the irregular islets of pale squamous epithelium which are often seen advancing over the columnar epithelium at the lower poles of the haemorrhoids. The patient should be asked to strain down into the proctoscope; this will permit the full degree of prolapse to be assessed and may show a bleeding point; a spurt of bright blood out of the speculum confirms the patient's history of blood spurting out onto the side of the water-closet pan.

Course and prognosis

The symptoms of internal haemorrhoids vary widely; at times they may be slight or absent, and then there may be periodical exacerbations, due sometimes to constipation, diarrhoea, and change of food or of routine. Usually they slowly progress over a period of years; bleeding at first is frequent and then becomes less as fibrosis develops. Prolapse, however, becomes increasingly worse, and eventually may curtail physical exercise.

Prolapse of rectum

An internal haemorrhoid which has reached the third degree of prolapse may in time drag on the lower rectal mucosa and produce a partial prolapse of the rectum.

Strangulation and thrombosis

Attacks of strangulation and thrombosis are commonly associated with surface ulceration and infection. Part or the whole of a pile may become gangrenous. More extensive sloughing of the rectum and possibly portal pyaemia are excessively rare complications.

Relation to malignancy

Any direct relation between internal piles and malignancy is extremely rare. Internal piles often co-exist with a rectal carcinoma, but in most cases of columnar-celled carcinoma of the lower third of the rectum there is no evidence whatsoever that haemorrhoids are of aetiological importance. The case illustrated in Fig. 43, however, is an example of a carcinoma which might have developed in a traction ulcer caused by a fibrous polyp of the anal canal.

Diagnosis and differential diagnosis

The diagnosis of internal piles involves (i) assessment of the degree of piles by inspection, digital examination, and proctoscopy; (ii) recognition of any exciting condition of importance, such as pregnancy, an enlarged prostate, or abdominal tumour; and (iii) discovery or exclusion of any other rectal lesion, such as a fissure, fistula, proctitis, or, most important of all, a carcinoma of the rectum or recto-sigmoid.

Differential diagnosis

The differential diagnosis is from external piles or skin tags, from partial prolapse of the rectum, and from benign tumours, such as rectal adenomas and papillomas, which may prolapse down to the anal margin or even outside the anal verge. In all of these conditions routine examination should clear up the diagnosis; the distinction between prolapsed piles and partial prolapse, however, is often very slight and of little practical importance, since the treatment of the two conditions is usually the same, i.e. by ligation.

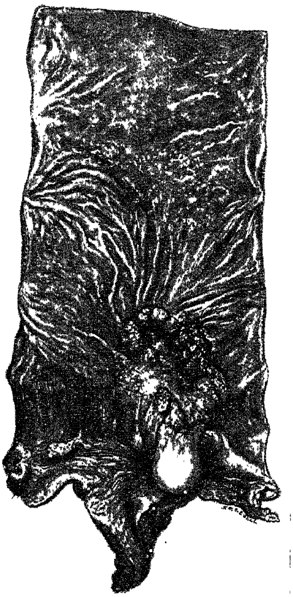


FIG. 43.—Fibrous polyp of anal canal associated with an adeno-carcinoma of lower rectum

Treatment

(i) *General*

Preventive

A regular natural action of the bowels should be encouraged by daily exercise, eating a reasonable amount of fresh fruit and vegetables and drinking plenty of water, and avoidance of irritating purgatives.

Symptomatic

In early cases, particularly in children, young adults, and pregnant women, medical treatment consists in regulation of the bowels with liquid paraffin; if constipated dry stools appear to aggravate the symptoms, the anal canal should be lubricated before defaecation with soft paraffin or a zinc oxide and castor oil cream, which may be inserted digitally or from a collapsible tube; an alternative method is to inject into the rectum before defaecation 3 to 5 fluid ounces of warmed olive oil through a syringe or a catheter and funnel.

Palliative

The treatment of prolapsed, thrombosed, ulcerated, or sloughing internal piles should be strictly palliative. No type of radical operation should be undertaken for these cases, for delayed healing and a troublesome chronic post-operative proctitis are liable to follow. The patient is put to bed under proper medical and nursing supervision. The anus is shaved, and an attempt is made to reduce the prolapsed piles into the rectum; pressure is applied either with gloved fingers or with gauze or cotton-wool swabs. Occasionally it may be advisable to induce a short anaesthesia by evipan sodium, which is ideal for these cases, to assist the reduction. Then, whether the reduction has been successfully accomplished or not, moist antiseptic compresses are firmly applied to the anus and renewed every four hours at first. Suitable lotions are mercuric chloride (1 in 2,000), eusol, Dakin's solution, or dettol (half a fluid ounce to one pint). After each action of the bowels the parts are inspected, irrigated, and re-dressed.

In some patients with a massive thrombosis in the lower rectum and much external oedema it is clearly impossible to effect reduction into the rectum, and reliance must be placed on obtaining gradual resolution by antiseptic compresses; lead lotion may be used after the acute stage has passed.

Healing stage

When the healing stage has been reached, a proctoscope should be passed, and, if any superficial ulceration in the pile-bearing areas is noted, local applications through the proctoscope of aqueous mercurochrome solution 2 per cent, compound tincture of benzoin, or ichthammol are indicated. If treated on these lines, aided by an adequate period of recumbency, the inflammation and oedema subside and complete spontaneous resolution may result. More often some degree of prolapse persists or returns after a short while, when further treatment by injection or operation may be required.

(ii) *Injection*

A historical survey of the injection treatment of haemorrhoids was published by Graeme Anderson (1924): it dates from 1869, when Morgan of Dublin used a solution of iron persulphate as a sclerosing injection for haemorrhoids. The use of phenol is ascribed to Mitchell of the United States (1871). At the present time 5 per cent phenol in almond oil with 2 grains of menthol to one fluid ounce is considered to be the safest and most effective solution and is injected into the submucous layer at the upper extremity of the piles (Albright's technique). The result of an injection into the internal haemorrhoidal plexus is a varying amount of thrombosis, followed by a fibrosis which not only obliterates the venous spaces but also tightens up the lax mucosa in the vicinity of the puncture; that a well placed injection can draw up the lower part of a soft pile is undoubted.

Solution used

Albright's technique

Indications for injection

Injection treatment should be reserved for *uncomplicated* internal piles of the first and second degrees. A careful examination is essential to select the suitable cases; a single small vascular pile is the type which reacts most favourably, and bleeding can generally be stopped by a single injection. Only rarely is it advisable to inject prolapsing piles of the third degree, for instance when operative treatment is refused or contra-indicated; in these cases some improvement may be obtained, but good results are likely to be transitory.

Technique

Anaesthesia is not required, nor is any special preparation or treatment needed before or after injection. The patient is examined in the left lateral or knee-chest position; after a preliminary proctoscopy the proctoscope is re-introduced to its full length and, after the needle (see Fig. 44) has been passed into the submucous layer, the phenol in oil solution (5 per cent) is injected (see Plate VIII).

The following details are important. (i) The puncture is made either at or just above the level of the ano-rectal ring, i.e. at the upper limit of the internal haemorrhoidal plexus. (ii) The quadrant selected for injection is usually that of the pile which has been proved to be bleeding or which is larger than the remainder. Sometimes, however, the injection is given in relation to two or three internal haemorrhoids at one session (see Fig. 45). (iii) The amount of phenol solution injected varies but is usually 2 to 3 c.c.; sometimes less suffices; sometimes, if the mucosa is very lax, 5 to 6 c.c. may be needed to distend the submucous layer suitably. (iv) Subsequent injections are given at intervals of 1 to 2 weeks, and in them more care is needed even than at first: if the tissues are at all sclerosed, the phenol in oil solution is only tolerated in small amounts. A white spot at the site of an injection shows either that the needle is too superficial or that the tissues are too fibrous to admit the solution.

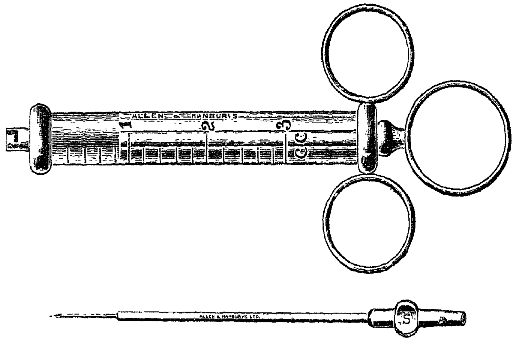


FIG. 44.—Author's pattern of syringe (3 c.c.) for the injection treatment of internal haemorrhoids. The straight needle, 20 Standard Wire Gauge, fits to the syringe with a bayonet joint

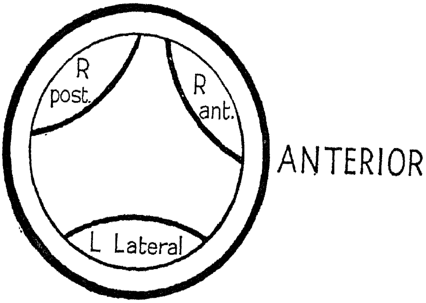
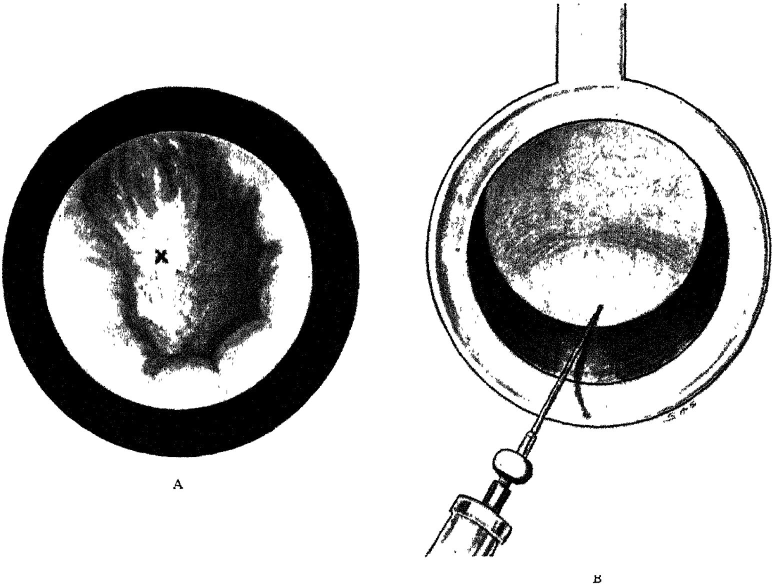


FIG. 45.—Diagram showing the three internal haemorrhoidal areas for injection. Rectum is viewed with patient in left lateral position

Complications Complications of injection treatment are due to wrong technique or injection of unsuitable cases. Superficial necrosis, massive thrombosis, submucous abscess, suppurative peri-proctitis, and secondary haemorrhage are all rare and avoidable complications.

Other solutions used Many other solutions have been described and are still used for the injection of haemorrhoids.



Injection treatment of internal haemorrhoids. A. The pile is visualized through a tubular proctoscope. The correct point for injection, at or just above the ano-rectal ring, is marked by a cross. B. The proctoscope has been re-inserted to its full length and a submucous injection of phenol in oil is being given at the upper limit of the pile. (From the Author's *Principles and Practice of Rectal Surgery*)

PLATE VIII

A 5 per cent sterile solution of quinine and urea hydrochloride is extensively used in many parts of the world by the technique described above. The 'strong' solution of phenol (20 per cent in equal parts of glycerin and water) is of use in certain cases for injection into the lower pole of a vascular pile; this may be done at the same time as the injection of the 5 per cent oily solution high up or subsequently.

(iii) *Surgical*

Indications Ligation is necessary when internal haemorrhoids are of long standing and have reached a severe degree of prolapse. The combined intero-external pile can only be cured by operation; and the same applies to internal piles which present palpable evidence of conversion into fibrous tissue or can be felt to be supplied by a large pulsating terminal branch of the superior haemorrhoidal artery.

Anaesthetic Ligation can be done under local, low spinal, or general anaesthesia. In elderly men with prostatic enlargement low spinal anaesthesia should be avoided, for there is a distinct risk that combined with the usual post-operative difficulty in micturition it may seriously disturb the bladder function and lead to prolonged retention of urine.

Milligan's technique Undoubtedly the best ligature operation is that described by Milligan and his co-workers. By this method the three primary piles are held out in artery forceps, and a second forceps is placed on the skin margin in relation to each pile. A V-shaped cut on to the skin enables the subcutaneous portion of the external sphincter to be defined, and a stout ligature of silk or chromicized catgut is tied round the pedicle of the pile immediately internal to the subcutaneous sphincter. This ligature not only secures the superior haemorrhoidal vessels supplying the pile but takes a grip of the expansion of the longitudinal muscle; the pile pedicle is thus prevented from retracting. The veins comprising the external haemorrhoidal plexus are removed in continuity with the internal piles, and at the conclusion of the operation a little more redundant skin may need to be excised with scissors in order to leave flat wounds which will heal by granulation. The insertion of a tube (½ inch outside diameter) and gauze dressings completes the operation.

By this technique, based on a study of the anatomy of the anal muscles, a complete and radical operation can be performed without leaving a raw surface in the anal canal, and post-operative oedema and the formation of skin tags, formerly common after incompletely performed ligature operations, seldom follow.

After-treatment The usual routine after operation is to remove the tube 12 to 24 hours after operation, leaving *in situ* the corners of dressing gauze which were inserted into the anus at the conclusion of the operation. An aperient is given on the second evening and the first bowel movement, aided by an olive oil and gruel enema, takes place on the third morning. Thereafter the patient may have a hot bath night and morning. The anus is irrigated with a dilute lotion such as hydrogen peroxide, dettol, or eusol, and a gauze dressing is lightly tucked in twice daily. A finger should be passed into the anal canal on the sixth or seventh post-operative day, and this should be repeated at intervals up to three weeks after operation.

(iv) *Post-operative complications*

Pain

Pain is the first and also the most variable complication after haemorrhoidectomy. It is minimized by a gentle and accurate operative technique and by careful attention to the many details of after-treatment. Some patients appear to have remarkably little pain, which can be relieved adequately by a few aspirin or veganin tablets, whereas others of a nervous temperament may have severe pain for the first 24 to 48 hours with troublesome spasm of the sphincter muscles, and for this morphine in some form is needed. The deep posterior injection of an oil-soluble anaesthetic such as anucaine, proctocaine, or percaine in oil is recommended by some surgeons as an adjunct to the operation and a prophylactic measure against post-operative pain.

Retention of urine

Retention of urine is a common post-operative complication after haemorrhoidectomy, being observed most frequently in nervous subjects: it is more prone to occur after spinal anaesthesia than when local anaesthesia alone is used. The hypodermic injection of 1 c.c. of doryl or esmodil has proved efficacious in stimulating contraction of the bladder musculature after operation, and in a series of cases reported by Stewart and Officer notably reduced the number of post-operative catheterizations. When retention is caused by an enlarged prostate interrupted catheterization may be needed for some days, possibly until the bowels have moved and the patient is fit to get up and have a bath: it occasionally proves necessary in these cases to tie in an indwelling catheter to overcome the retention, and at a later date removal of the prostate or endoscopic resection of the middle lobe may be required.

Reactionary haemorrhage

Reactionary haemorrhage may be due to slipping of one of the main ligatures and must be accounted as an error of technique, i.e. failure to transfix the pile pedicle, application of an insecure knot, or excision of the pile mass too close to the ligature so that slipping becomes possible. Haemorrhage from a marginal (inferior haemorrhoidal) vessel may occur, and is sometimes started by the post-operative vomiting associated with general anaesthesia; the bleeding point should be secured with artery forceps and ligated.

Secondary haemorrhage

A secondary haemorrhage into the rectum, at first concealed and then revealed by slight oozing of dark blood from the rectum or by the expulsion of a large amount of blood and clot, occurs rarely after a haemorrhoid operation between the sixth and tenth post-operative days. The incidence formerly was 1 per cent (Gabriel) but now it is certainly not more than 0·5 per cent (1 in 200), the decrease being due to more careful selection of cases for operation: it seems likely also that the adoption of Milligan's technique, with the secure anchoring of the three main ligatures, will obviate premature separation of the ligatures and make severe secondary haemorrhage a still more rare complication. The treatment required for dealing with an established secondary haemorrhage is to pass a proctoscope and irrigate the rectum clear of blood and clot. A rubber tube with a gauze 'surround' is passed through the proctoscope and is left in the rectum for forty-eight hours.

A large safety-pin is passed through the tube immediately external to the anus and by winding a gauze roll beneath the safety-pin some pressure can be exerted on the bleeding vessel. This method of controlling the haemorrhage is more satisfactory than an attempt to find and ligate the vessel. The tube can be removed later by traction after giving an injection of morphine. Olive oil may be injected through the tube beforehand.

Oedema and tags

Post-operative oedema and formation of large skin tags are caused sometimes by excessive straining efforts at micturition, by persistent vomiting, or by severe constipation after operation. Tags also result from errors of technique, with failure to remove the redundant skin and underlying external haemorrhoidal plexus in relation to the three primary piles.

Fissure

A fissure in the anal canal is an occasional sequel to operation, especially after removal of a fibrous polyp accompanied by sphincteric spasm. In such cases adequate external drainage after removal of the polyp and injection of an oil-soluble anaesthetic are the usual methods of preventing this complication.

Inflammatory complications

Inflammatory complications such as anal abscess and post-operative ulceration are due principally to technical errors, injudicious selection of septic cases for operation, and inadequate after-treatment.

Stricture

Stricture of the anus and anal canal is caused by removal of too much skin from the anal margin and by inclusion of an excessive amount of tissue in the main ligatures. The passage of a finger or a short dilator of the St. Mark's Hospital pattern at intervals after the sixth or seventh post-operative day is essential to a good result and failure to do this may allow a stricture to develop which otherwise would be prevented.

2.–PROLAPSE

Definition

Partial

1347.] A prolapse of the rectum is said to be partial or incomplete if only the mucosa projects beyond the anal margin (see Fig. 46, *a*). A complete prolapse (see Fig. 46, *b*) consists of the entire thickness of the rectum (mucous, submucous, and muscular layers), and in many cases, particularly in women, the anterior wall of the prolapsed rectum contains also the lowest part of the peritoneal recto-uterine excavation (pouch of Douglas).

Complete

Aetiology

Partial prolapse in children

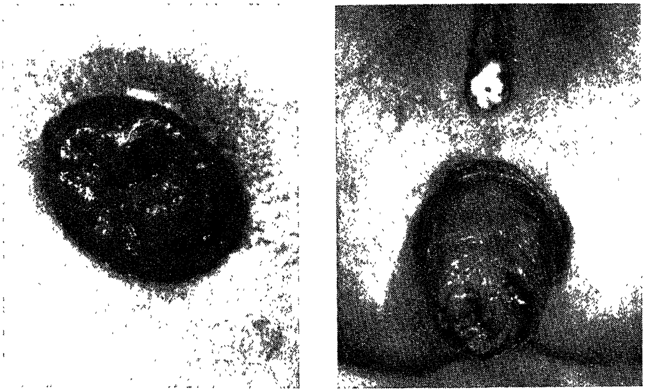
Partial prolapse of the rectum is not uncommon in children between the ages of 1 and 3 years. Certain anatomical factors in children have been suggested as of importance, such as the slight development of the sacral curve and the relatively long pelvic colon, both of which conditions may favour the development of prolapse, especially when the child defaecates in the sitting position on a high closet. Loss of the supporting fat in the ischiorectal fossae, due to malnutrition or any severe illness, is a factor in some cases. Excessive straining due to diarrhoea, enteritis, vomiting, whooping-cough, or chronic bronchitis may be responsible. Whatever the general health of the child, and most are well nourished, the usual chief cause of prolapse is some irregularity in the bowel function. Lazy habits about defaecation have often been developed, with bouts of constipation relieved by purgatives.

Complete prolapse in children

In children a complete prolapse of the rectum is rare and invariably begins as a partial prolapse.

Partial prolapse in adults

In adults partial prolapse is commonly an advanced stage of prolapsing internal haemorrhoids and may be aggravated by chronic constipation or the straining associated with enlargement of the prostate or with urethral stricture. It may be produced also by any condition causing sphincteric relaxation, such as old age, lesions of the central nervous system, and the debility after any severe illness. Partial prolapse may follow a rectal operation, such as Whitehead's operation for haemorrhoids and a fistulectomy in which the external sphincter has been widely divided, particularly on the lateral aspect of the anus.



(a) (b)

FIG. 46.—(*a*) Partial prolapse of rectum; (*b*) complete prolapse of rectum

Complete prolapse in adults

In complete prolapse of the rectum in adults several aetiological factors are important. Most of the cases which occur in parous women are no doubt due to the relaxation of the soft tissues of the pelvis, with separation of the levatores ani muscles and possibly old lacerations of the perineum. Yielding of the pelvic fascia, with formation of a peritoneal sac which in its descent drags down a sliding hernia of the anterior rectal wall, is the accepted explanation of most adult cases (Moschowitz's hypothesis); increased intra-abdominal pressure, due to many factors, such as repeated straining efforts and increasing adiposity, may also be important. In some cases the yielding of the pelvic floor is only one item in a general visceroptosis and may be combined with other hernial protrusions.

Clinical picture

Examination

A prolapse of the rectum, whether in children or in adults, must be seen fully prolapsed before a satisfactory estimate of the case can be made. A partial prolapse is seen as a smooth mucosal prolapse either circular or involving one lateral aspect. The exposed mucous membrane is usually thickened and hyperaemic and may bleed if touched. A complete prolapse is much larger; its length outside the anus is usually 2 to 6 inches, and it is characteristic of a long prolapse that the extruded bowel curves posteriorly; this is because the meso-rectum is attached posteriorly, whereas the anterior rectal wall is more free. Voluminous circular folds of mucosa characterize this degree of prolapse.

Palpation

Palpation of the prolapse between a finger and thumb enables a distinction to be drawn between the thin double layer of mucosa which constitutes a partial prolapse and the much greater thickness of a complete prolapse composed of two complete layers of the rectal wall. If the anterior wall of a complete prolapse is examined bi-digitally, the added thickness of the peritoneal pouch can often be made out, and, if this pouch contains small intestine, the bowel can often be felt to slip upwards with a gurgle. This can be confirmed by asking the patient to cough and then repeating the manœuvre.

Examination of tone of sphincters

Slight degrees of partial prolapse seldom produce any changes in the efficiency of the anal sphincters, but in adults with long-standing prolapse, partial or complete, varying degrees of weakness of the external sphincter are common. These changes are produced by repeated overstretching of the muscle, and an estimate of the tone of the external sphincter ani may be made in two ways: (i) if the sphincter is obviously patulous, the patient should be asked to try to tighten the muscle; it may be so atonic that it will not close, or the patient may succeed in contracting the muscle sufficiently to grip the examiner's finger; (ii) with a finger in the anal canal, some traction should be made on the sphincter; with normal sphincteric tone it should not be possible to open the anal canal, whereas in chronic prolapse the sphincter becomes so stretched and weakened that a slight pull in any direction causes the anal orifice to relax.

Examination of levatores ani

The contractile power of the levatores ani muscles may also be estimated, and in women a wide separation of the levatores can often be detected on rectal examination. Bulging of the perineum due to this cause and the presence of a rectocele can be ascertained by asking the patient to cough or strain down. Scars resulting from previous operations, such as perineal repair and excision of a fistula in ano, will be visible, and evidence of a Whitehead's operation obvious.

Operation scars

Symptoms in children

The symptoms are progressive according to the degree and chronicity of the prolapse. In children a partial prolapse causes only temporary discomfort or pain from the anal distension, with slight bleeding on defaecation; as soon as the prolapse is replaced at the end of defaecation no further symptoms are noted. To the parents the condition often looks much more distressing than it is.

In adults Partial prolapse in adults causes symptoms identical with those of third-degree prolapsing piles; in addition to the prolapse there are mucoid discharge, bleeding, irritation, and occasional slight incontinence of wind or faeces.

In complete prolapse the symptoms are exaggerated and progressive. As the tone of the anal sphincters becomes gradually impaired, the prolapse descends when the patient walks or bends, and active exercise has to be discontinued, or some form of support is often adopted. Incontinence of faeces is frequent, and much difficulty is usually experienced in regulating the bowels.

Course and prognosis

The progressive nature of rectal prolapse has already been indicated; the length of the prolapsed bowel is not so important as the stretching and weakening of the external sphincter ani, which necessarily follow the more frequent or continual descent of the prolapse.

Complications The prolapsed rectum is liable to undergo the same inflammatory complications as prolapsing haemorrhoids: congestion, ulceration, and thrombosis. The prolapsing mucosa usually shows chronic catarrhal proctitis, manifested by the outpouring of large quantities of clear mucus. Bleeding is caused by friction with the clothing or by trauma during movement and may be considerable; large dilated veins exposed on the surface of the prolapsed rectum indicate the possibilities in this direction.

Strangulation Strangulation of a complete prolapse is rare and is most liable to happen after the first descent of a prolapse when the sphincter tone is sufficiently good to grip the prolapsed bowel tightly. Later the impaired sphincteric power negatives this complication.

Rupture of wall Rupture of the anterior wall of a complete rectal prolapse (rectal hernia) is an extremely rare and usually fatal complication; it has taken place after some unusual straining effort, such as vomiting or lifting a heavy weight, and the resulting extrusion of coils of small intestine constitutes a very difficult and dangerous problem.

Diagnosis and differential diagnosis

Assessment of degree of prolapse A prolapse of the rectum seldom causes any difficulty in diagnosis apart from the assessment of the degree of prolapse. Thus in children it is sometimes difficult to decide if a prolapse is partial or complete; the increased thickness of a complete prolapse has already been mentioned (see p. 511). A peritoneal sac will certainly be present in the anterior part of any complete prolapse the length of which outside the anus is more than two inches (Tuttle).

Diagnosis from piles In adults it is often difficult to distinguish between prolapsed third-degree piles and a partial prolapse of the rectum, and this is rather a matter of opinion in any particular case.

From tumour and intussusception The diagnosis must be made from a large benign tumour, such as an adenoma and a villous tumour presenting at the anus, and from the rare intussusception of the pelvic colon into the rectum (procidentia sigmoidae). In these cases routine rectal examination with proctoscopy and sigmoidoscopy will clear up the diagnosis. In children an ileocaecal intussusception rarely reaches the anus but should be readily recognized by the acute onset together with the general and abdominal symptoms inseparable from the condition.

Treatment

(i) *Symptomatic*

Medical treatment suffices for many cases of prolapse in children. Attention to the general health and inculcation of regular bowel habits are chiefly of importance. As the home surroundings and parental influence of many children with prolapse are unsatisfactory, it is usually advisable to recommend treatment for a few weeks in a hospital or nursing home, where the child can be re-educated by trained children's nurses.

Control of defaecation in children

Lazy, spoilt, constipated, or over-purged children soon settle down to regular habits of defaecation if their diet and general routine are planned on sensible lines. Constipation can usually be overcome by giving plenty of water to drink, with teaspoonful, or larger, doses of liquid paraffin night and morning. A trial of defaecation after breakfast must be persevered with until it becomes a regular daily habit; each session should be short, and the child should not be allowed to sit on a chamber for lengthy periods. Laxatives, such as cream of magnesia or syrup of figs, may be needed, but strong aperients should be avoided.

In refractory cases a small saline or olive oil enema may at first be needed each day. The enema is given with the child lying on his left side and is passed in the same position, while the nurse is in attendance and ready to support the anus posteriorly if there is any sign of extrusion of the mucosa.

Supports for adults

Symptomatic treatment is also indicated in certain adult cases of complete prolapse when senility or mental impairment renders any active treatment inadvisable. In these some form of support may be tried: a sanitary towel with a T-bandage may suffice, or a surgical appliance may be needed: one fairly good pattern has a broad waist-band and, coming forwards between the legs, two strong rubber tubes fastened in front with straps.

(ii) *Injection*

Phenol in almond oil

In some cases of partial prolapse, both in adults and children, the lax mucosa may be treated by injection. The technique is similar to that already described in the treatment of internal haemorrhoids (see p. 507), except that in the present instance the injections of 5 per cent phenol in almond oil are given through a proctoscope into the submucous layer, first as high up as can be reached; then at subsequent treatments the loose mucosa lower down is treated in a similar way by multiple punctures, the object being to fix the mucosa to the muscular layer. In adults a maximal dose at one session is about 10 c.c. of the solution, and in children 3 to 5 c.c. may be injected.

Peri-rectal injections

Another type of injection may be given peri-rectally, in order to produce adhesions between the rectum and the peri-rectal tissues. One of the best solutions is absolute alcohol; this is chiefly used for the treatment of severe prolapse in children; the technique is that of D'Espine as described by Findlay.

Technique in children

Under general anaesthesia 1·5 c.c. of absolute alcohol are injected, through a fine 3-inch needle, on each postero-lateral aspect of the rectum. The punctures are ¼ to ½ inch external to the anus, and a forefinger in the anal canal guards against passage of the needle too close to the rectum. A plastic peri-proctitis develops, and in order to take full advantage of this the child's buttocks are strapped together for a week after injection.

In adults

In adults a similar technique for peri-rectal injection may be employed under local anaesthesia; 15 to 20 c.c. of 1 in 3,000 hydrochloric acid or of warmed sterile castor oil have been advocated by Hanes for injection on each side of the anus; he, however, mentioned two types of patient who are not suitable for injection: those with chronic diarrhoea and those who tend persistently to strain at stool.

(iii) *Surgical*

The large number of operations which have been advocated for rectal prolapse is a commentary on the difficulty of treatment.

Van Buren's operation

In children, linear cauterization described by Van Buren undoubtedly gives good results if the after-treatment is careful.

Ligature

Most cases of partial prolapse in adults are treated by ligation. A complete circle of prolapsing mucosa is split with scissors into three main portions, which correspond in position to the three primary piles (see p. 503); these are then ligated with catgut. Small intervening strips of mucosa are left anteriorly and posteriorly, and care is taken not to produce a stricture.

Recto-sigmoid-ectomy

Moschowitz's operation

In the treatment of complete prolapse in adults two major operations are now in accepted practice. Amputation (recto-sigmoidectomy) gives excellent results, particularly in a long prolapse, for by this method the loose pelvic colon is delivered externally and excised; circular repair by suture completes the operation, and by regular sphincter contractions subsequently the sphincter tone generally soon improves when the descent of the prolapse has ceased. Moschowitz's operation is an abdominal operation, the object being to obliterate the recto-uterine excavation (pouch of Douglas) by a series of linear thread sutures placed circularly round the pelvis. The operator faces distinct technical difficulties and must avoid injury to the ureters and pelvic veins. The operation has given good results and is a much sounder method than any form of colopexy.

3.–RECTAL INCONTINENCE

Aetiology

Congenital defect

1348.] Imperforate anus is commonly associated with congenital absence or faulty development of the external sphincter ani (see Vol. V, p. 360).

The anal canal may be restored by incision or dilatation, but some lack of normal sphincteric control, associated with a funnel-shaped anus, may persist throughout life. In such cases the levatores ani muscles usually hypertrophy and function fairly adequately, except when the motions are loose, when some involuntary leakage is liable to occur.

Prolapse

Acquired incontinence is an occasional symptom of prolapsing piles of the third degree and of partial prolapse of the rectum. In complete prolapse the external sphincter becomes progressively stretched, until the resting tone of the muscle fails to close the anal canal. The muscle may become so attenuated that even by voluntary contraction the patient is unable to grip a finger, and leakage of wind and faeces is inevitable.

Debility and old age

The debility following any serious illness may temporarily be indicated by occasional faecal incontinence, and senile muscular atrophy may cause the same condition.

Sodomy

In young subjects presenting a patulous anus with a history of a mucous or faecal discharge the possibility that the patient may have been subjected to rectal coitus must not be overlooked: a chronic proctitis is additional evidence and indicates the need for careful questioning.

Lesions of central nervous system

Sphincteric weakness occurs in lesions of the central nervous system, such as tabes dorsalis and disseminated sclerosis. Incontinence is also a feature of severe head injuries and of over-dosage with hypnotics, such as chloral hydrate and paraldehyde.

Surgical injury

Surgical injury of the external sphincter ani fairly commonly causes incontinence; ill advised division of the sphincter in the course of opening an acute ischiorectal abscess and too extensive or badly planned operations for cure of fistula in ano are liable to be followed by irremediable damage to the sphincter, particularly when the incisions are made anterior to the transverse anal line. Even if the sphincter is not completely divided, incontinence may be caused by excess of scar tissue hindering the free action of the muscle; this may happen after careless or unskilfully performed haemorrhoidectomy if sufficient care has not been observed, especially by the Whitehead method, in which another cause of incontinence may be the loss of the normal epithelium of the anal canal. Perineal excision of the rectum with formation of a perineal or sacral anus is followed by incontinence, and for this reason a permanent colostomy is usually considered to be an essential preliminary. Complete tears of the perineum during labour, and any stab, impalement, or gunshot wound involving the sphincter may also be followed by incontinence.

Obstetric injury and trauma

Clinical picture

Incontinence associated with prolapse is readily assessed (i) by digital traction on the external sphincter to determine the degree of relaxation, and (ii) by asking the patient to strain down; the unfolding of the prolapse and the degree of distension of the sphincter can quickly be ascertained. In obstetrical injuries the dimples marking the retracted ends of the external sphincter can be seen, and after any surgical or accidental injury the amount of scarring and the contractile power of the sphincter can be noted. Digital examination will show if the anorectal ring is intact.

Course and prognosis

The prognosis depends on the cause of the incontinence. Some cases, such as those due to debility, are recoverable; others, such as those due to prolapse in any degree, are capable of great improvement. The worst cases are those in which the external sphincter has been wrongly divided in the course of a surgical operation for abscess or fistula, and in these, although something may be done by surgical or other methods to improve the condition, it is seldom possible to obtain a complete cure and the patient has always to be careful about the bowel function and to avoid loose uncontrollable actions.

Treatment

Surgical treatment

Surgical treatment consists in the cure of prolapsing haemorrhoids and of partial or complete prolapse of the rectum (see pp. 506 and 515). The patient's co-operation subsequently in carrying out voluntary contractions of the external sphincter and levatores ani muscles is important in the after-treatment. Operations designed to pleat or shorten a relaxed sphincter through a curved posterior incision have not met with much success. Perineal tears extending into the anal canal are treated by perineorrhaphy, every effort being made to identify and bring together the ruptured ends of the external sphincter.

Perineorrhaphy

Plastic operations

In incontinence due to previous surgical or traumatic injuries plastic operations for repair of the damage may be attempted; the operation usually consists in excision of scar tissue, followed by identification and suture of the residual sphincter muscle. The difficulties, however, may be insuperable, for the gap often cannot be bridged either by sphincter muscle or by the lining of the anal canal; even if the immediate result appears to be satisfactory, local sepsis is prone to develop and the final result may not show any improvement. In such cases it might be preferable to establish a temporary left iliac colostomy as a preliminary and to delay the plastic operation until the lower rectum has been thoroughly cleaned by wash-outs. The risk of faecal contamination would thus be considerably reduced, and the eventual closure of the colostomy would be left until the anal wound had healed firmly. In the worst type of case a permanent colostomy may be advisable, but the case should be most carefully reviewed before this step is taken.

Colostomy

Electrical treatment

In addition to voluntary contraction of the external sphincter and levatores ani muscles, which should in all cases be done as an exercise at least twice daily, the faradic current may be used with advantage. 'Surging' faradism (see Vol. IV, p. 500) is usually given in three sessions a week for several months; a recent refinement is an instrument known as the indolor in which the ineffective stimuli felt as pain are eliminated.

Symptomatic treatment

Symptomatic treatment is all that is possible in some cases; in senile faecal leakage, in nervous diseases, and in some old traumatic cases the symptoms are minimized by the avoidance of liquid paraffin and aperients and by the administration of an enema on alternate days. The diet should be mainly of the low-residue type, and the intestinal digestion if faulty or hurried will require medical treatment.

4.–RECTAL NEURALGIA

Aetiology

1349.] Under this rather comprehensive term are included those not uncommon cases of acute or chronic pain in the region of the rectum which are not due to any anal lesion such as a fissure or abscess. The following forms may conveniently be grouped together.

Rheumatism

Aching pain, aggravated by bending or physical exercise and subject perhaps to the vagaries of the weather, is a common type of rectal neuralgia and is probably of rheumatic origin, being a rheumatic myositis or fibrositis affecting the levatores ani and coccygeus muscles and their insertions into the sides of the coccyx.

Coccygodynia

For the causes of coccygodynia see COCCYX DISEASES, Vol. III, p. 259.

Proctalgia fugax

Attacks of sudden severe pain in the rectum, usually at night, have been termed proctalgia fugax by Thaysen. The pain has been described as aching, cramp-like, or stabbing, and is probably caused by spasm of the levatores ani muscles, which may be brought on by such causes as an accumulation of wind in the rectum (possibly caused by a tight sphincter), sexual over-activity, and excessive purgation; it has also been regarded as a manifestation of epilepsy (rectal aura).

Tabes dorsalis

The rectal crisis of tabes dorsalis is a rare form of visceral crisis; the pain is paroxysmal and very severe, like that of a wedge being driven into the anus; it may be accompanied by diarrhoea, tenesmus, or bleeding.

Prostatic origin

In elderly men a chronic neuralgic pain in the perineum, aggravated by sitting, may be caused by inflammation and enlargement of the prostate. In carcinoma of the prostate a vague perineal pain is frequent, and these patients often at first believe their symptoms to be of rectal origin.

Gynaecological causes

In women a complaint of a heavy bearing-down feeling in the rectum, aggravated by prolonged standing, is sometimes due to a relaxation of the supports of the rectum. Without any visible external prolapse there may be a distinct bunching together of the rectum, like the closing of a concertina; some degree of uterine descent may be present. In other cases the cervix may be unduly prominent from the rectal aspect, or a marked degree of retroflexion may be present, with the fundus of the uterus pressing back heavily into the anterior wall of the rectum. Endometrioma invading the recto-sigmoid has also given rise to a chronic aching pain high up in the rectum, usually worse at the menstrual periods.

Sacro-iliac strain

Obscure rectal pain in conjunction with low backache may be caused by sacro-iliac strain (Malcolm R. Hill). Spasm of the piriformis muscle is said to be present in some cases and may be secondary to irritation or disease of the sacro-iliac joints.

Clinical picture

Nature and time of the pain

The different causes of rectal neuralgia produce various symptoms, but they have this in common, that the pain, whatever its character, is not brought on by defaecation or aggravated after defaecation. On the contrary, the statement that the pain is noticed at any time of the day or night and is made worse by sitting, movement, or driving a car should suggest a non-rectal cause of the symptoms.

Diagnosis

The diagnosis of the cause of rectal neuralgia depends on a careful evaluation of the history. Examination should exclude a reasonable cause for the symptoms in the rectum or anal canal; sigmoidoscopy and proctoscopy should be negative, and there should be no lesion in the anal canal, such as a fissure, cryptitis, or old scarring to which the symptoms might be attributable.

If an old injury to the coccyx is indicated by the history and the presence of a thickened, deformed, unduly mobile or tender coccyx, a lateral radiograph may be helpful (see Plate IX, A).

Digital examination of the rectum is important and detects spasm of the levatores ani muscles and tenderness along the line of insertion of the muscles into the coccyx, which is so characteristic of a rheumatic condition. Prostatic enlargement and uterine abnormalities can also be detected, and the necessity for consideration of these cases from the gynaecological, urological, and orthopaedic view-points is evident.

Treatment

Treatment depends entirely on the results of examination as indicated in the preceding section.

Alcohol injection

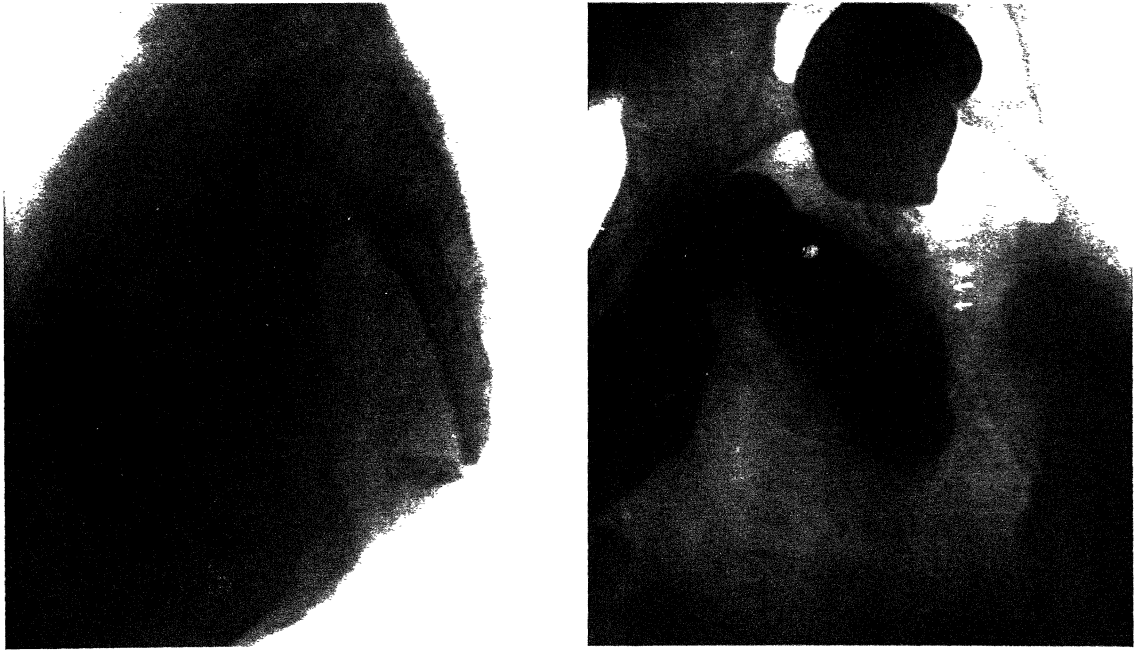
Genuine coccygodynia, in which the coccyx is deformed and exquisitely tender on bi-digital movement, is sometimes cured or relieved by alcohol injections. The technique has been described by Yeomans and consists in the injection of 10 to 20 minims of 80 per cent alcohol from a midline puncture directly into the most tender point. Usually two to ten treatments are required at intervals of about a week. Excision of the coccyx followed by primary suture of the wound has proved the most satisfactory treatment in severe cases; not only is the tender deformed coccyx removed, but its muscular attachments are severed, and probably the irritated coccygeal nerves are also divided.

Massage

Rectal neuralgia, in which spasm of the levatores ani muscles is noted, may be treated by massage of the muscles with a finger in the rectum; the sessions are repeated at intervals until the muscle is felt to be relaxed and the symptoms are relieved (Thiele).

Physiotherapy

Radiant heat and the application of short-wave diathermy to the sacro-coccygeal region may prove helpful in some cases.



A B

A. Lateral radiograph of pelvis showing forward fracture-dislocation of coccyx. B. Radiograph after barium sulphate enema, showing stricture (marked by arrows) caused by recto-sigmoid carcinoma

PLATE IX

[*To face p.* 520

For the relief of severe pain aspirin, compound aspirin, or veganin tablets may be given by the mouth. *Relief of pain*

5.–FAECAL IMPACTION

1350.] Impaction of a hard, round or oval faecal mass in the ampulla of the rectum occurs particularly in aged subjects and in those with atony of the bowel wall. It is probably commoner in those with a small fibrous anal canal and is very prone to occur in patients who are confined to bed for long periods. The mass is usually single but occasionally multiple, when hard faecal masses may be palpable also in the colon. A hard collection, partly barium sulphate and partly faeces, is not uncommon in the rectum after a barium sulphate meal or enema; a similar mass may slowly form in the rectum after a Hartmann's operation (abdominal resection of the pelvic colon) and is composed of residual faecal material left in the rectal stump together with inspissated mucus. *Aetiology*

Faecal impaction is also prone to occur when the rectum has been temporarily put out of action, e.g. by a colostomy in the course of a Paul-Mikulicz resection; after final closure of the colostomy a good deal of care is required to prevent a large firm faecal mass from collecting in the rectum.

The symptoms of faecal impaction are often misleading. The patient may complain of constipation or of diarrhoea due to the passage of watery faeces round the faecal mass; alternating constipation and diarrhoea, a heavy bearing-down feeling in the rectum, occasional bleeding, and slight incontinence may all be reported in various degrees. *Symptoms*

A hard faecal mass impacted in the rectum can be diagnosed digitally by its mobility and by the fact that the finger can be swept all round it. Pitting can be detected, and the fact that the mass can be broken up digitally without causing pain is conclusive evidence of its nature; sigmoidoscopy and proctoscopy confirm the presence of a hard brown faecal mass, which may, however, be somewhat obscured by a covering of blood. It must be diagnosed from an adenoma, carcinoma, or other organic lesion and from an impacted foreign body. *Diagnosis*

A hard faecal mass the size of an egg can sometimes be neatly removed from the rectum by passing a tubular proctoscope and grasping the mass with a volsellum forceps through the proctoscope; both the mass and the proctoscope are removed together. In other cases it may be necessary to break up the faecal mass and remove part of it with a finger, the remainder being left to be passed by the patient. If the anus is stenosed, it may be advisable to stretch the anal canal carefully under an anaesthetic, and then to remove or break up the faecal concretion. A daily olive oil and gruel enema, with an occasional glycerin enema, must be given until the rectum is clear. It is often very difficult to relieve a senile patient of a faecal mass with the consistence of putty; *Treatment* it may be necessary to remove it digitally at several sittings, and to clear the rectum by enemas aided by aperients.

6.–INJURIES

Aetiology

1351.] Injuries of the rectum are uncommon but important because of the risk of infection. *Laceration* Slight laceration of the anal canal may be caused by small sharp foreign bodies, such as particles of glass or enamel, in the stools; such lacerations are prone to take place in relation to the anal crypts and valves and may result in fissures or abscesses. *Impaction of foreign body* Spiculated foreign bodies, such as pieces of chicken and rabbit bones and stout fish bones, occasionally become impacted in the anal canal, leading to the formation of an anal or ischiorectal abscess in a high proportion of cases. Large foreign bodies which are sometimes inserted into the rectum by maniacs or criminals are difficult to remove without damaging the rectum or anal canal. *Penetrating and gunshot wounds* The rectum may be penetrated by falls on pointed objects, such as palings or pitchforks. Gunshot injuries are an extremely dangerous type of war injury.

Rupture Rupture of the rectum from excessive straining, rupture of a rectal hernia, and rupture of the recto-sigmoid from application of a nozzle delivering compressed air to the anus (Wyllys Andrews) are other types of injury.

Surgical injuries Surgical injuries of the rectum may occur in the male in the course of perineal prostatectomy or external urethrotomy, and in the female in the course of vaginal or pelvic operations. Perforation by a sigmoidoscope or by the passage of a long rectal bougie of the Wales's type is also rare. An important injury is that caused by hard enema nozzles *Injury by enema nozzles* of bone, glass, or vulcanite, which may, as the result of lack of skill by the administrator or sudden movement on the part of the patient, be thrust into the anterior or posterior wall of the lower rectum. The subsequent forcible injection of unsterile irritating soap solution by a Higginson syringe is usually followed by the gravest complications.

Clinical picture

The signs and symptoms vary according to the nature of the injury. *Fissure* A traumatic fissure in the anal canal produces acute pain noticed first *Impaction of foreign body* during defaecation and accompanied by slight bleeding. Impaction of a sharp foreign body in the anal canal causes a similar pain, which is aggravated by movement and later, with the formation of a submucous *Perforation* or peri-anal abscess, may be throbbing. In perforation of the rectum with an enema nozzle there is a history of acute pain and collapse during the administration of an enema, with slight bleeding from the anus. An acute febrile illness rapidly develops, with acute toxaemia and perhaps rigors; rectal tenesmus with discharge and bleeding is prominent. *Penetrating injuries* Severe penetrating injuries of the rectum cause considerable immediate shock, with risk of haemorrhage and early peritonitis, and involvement of the pelvic bones or viscera, such as the small intestines or bladder. If any delay ensues between the receipt of the injury and treatment, signs of acute pelvic cellulitis will probably be apparent, with high fever and a brawny induration of the buttocks. Associated injury of the bladder will be indicated by haematuria, retention of urine, or development of a urinary fistula or extravasation.

Diagnosis

Injuries of the anal canal are invariably followed by acute spasm of the external sphincter, so that it may be difficult to define their nature or to detect an impacted foreign body until an anaesthetic has been administered. In any penetrating injury, including injury from an enema nozzle, the perforation in the rectal wall can usually be clearly felt with the examining finger and be confirmed by proctoscopy or sigmoidoscopy. A perforation is seen as a ragged hole in the rectal wall with discharge of blood and pus; if anaerobic infection has developed, bubbles of gas can sometimes be observed coming from the perforation.

In penetrating or gunshot wounds of the rectum it is usually impossible to assess the full extent of the damage clinically. Only low gunshot wounds can be expected to have involved solely the extraperitoneal portion of the rectum, and in most cases the accurate diagnosis of the extent of the injury must be settled by laparotomy.

Treatment

Traumatic fissures

Surgical treatment is required in practically all cases. In acute traumatic fissures immediate relief of pain and early healing may be brought about by relaxing the external sphincter with a deep posterior injection of proctocaine or percaine in oil (see Vol. I, p. 649).

Foreign bodies

Impacted foreign bodies should be removed, the sphincter stretched, and sterile soft paraffin injected. The subsequent formation of an abscess will call for appropriate incision and drainage.

Perforation

The more severe forms of injury, whether impalement or gunshot, must be treated by exploratory laparotomy at the earliest possible time after receipt of the injury. Closure of a perforation of the upper rectum is effected by interrupted sutures of chromicized catgut. Multiple injuries of the colon and small intestines must be searched for and dealt with according to their nature. In the majority of severe injuries with peritoneal contamination the pelvis must be drained through the lower end of the abdominal incision.

Colostomy

A temporary left iliac colostomy is of inestimable value, provided that it is done at once before the onset of septic complications. The colostomy is brought out through a separate left-sided muscle-splitting incision and the two limbs of the colon are sutured together in preparation for the eventual closure. The colostomy should be opened at once in order to prevent gaseous distension of any sutures that have been inserted in the rectal wall and to obviate further faecal contamination of open wounds in the rectum below the peritoneal floor.

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Free external drainage must be provided for the severe types of enema injury and buttock wounds involving the lower rectum; foreign bodies or loose portions of bone should be removed, and watery antiseptics, such as flavine, eusol, and dettol, are advisable for the dressings.

Antitoxins

Full prophylactic doses of tetanus antitoxin and gas-gangrene antitoxin should in all cases be given. Administration of sulphanilamide should be considered, either as a prophylactic or in the early stages of wound sepsis with pyrexia.

7.–PROCTITIS

Definition

1352.] Proctitis is a comprehensive term which includes all types of inflammation of the rectal mucosa. Sometimes the inflammation is limited to the rectum, but more usually it is associated with a similar condition of the colon so that strictly speaking it is a procto-colitis; the recognition of this fact by sigmoidoscopy is essential for accurate diagnosis and treatment.

Simple catarrhal proctitis may be acute or chronic. In some forms the infecting organism is alien to the usual intestinal flora.

Aetiology

General causes

Some individuals are liable to develop procto-colitis. Such factors as heredity, allergy, vasomotor disturbance, vitamin deficiency, and endocrine dysfunction have been postulated, and it seems certain that factors other than infection must be present in many cases. In these sensitive individuals an attack of proctitis may be caused by overwork or strain, emotional storms, worry, exposure to cold, or abdominal chills. There may possibly be a seasonal incidence, because many new cases, as well as recrudescences, seem to occur in the spring. Pregnancy also is commonly associated with attacks of procto-colitis, but whether it acts by direct pressure on the bowel, diminished resistance, or some alteration in metabolism is not certain. Acute influenza or any streptococcal infection may produce an acute proctitis or be responsible for periodical recurrences.

Exposure

Streptococcal infections

Dietetic errors

Food poisoning of any type is cited as the beginning of chronic intestinal trouble which proves to be a procto-colitis; an attack of intestinal indigestion from bolting hard or imperfectly cooked food may act similarly. Idiosyncrasy to foods, such as shell-fish, caviare, mushrooms, and fruits such as strawberries and gooseberries, is a well established cause of proctitis. Alcoholic excess is also a possible cause.

Constipation

Chronic constipation and the passage of scybala through the large bowel are undoubtedly a common cause both of original and recurrent attacks of proctitis. Proctitis is constant when a hard faecal mass or foreign body becomes impacted in the rectum, and closely related is the proctitis which occurs above a rectal stricture.

Irritation from purgatives

Purgatives such as castor oil, aloes, and calomel are liable to set up a proctitis; phenolphthalein, a common constituent of many proprietary aperients, is undoubtedly harmful in this respect, as also are many saline cathartics, especially when taken to excess; the devotees of 'slimming' by this method are liable to proctitis.

Injury

Any injury of the rectum is necessarily followed by some degree of proctitis, which is seen at its maximum after the administration of corrosive or scalding-hot enemas. Even a soap-and-water enema properly administered may set up a slight and transient proctitis, and patients who habitually use colonic lavage invariably show some changes characteristic of chronic proctitis.

Rectal anaesthetics

Proctitis is also not uncommon after the rectal injection of avertin or paraldehyde as a basal anaesthetic and indicates the advisability of evacuating as much of the drug as possible through a rectal tube at the end of the operation or if possible sooner. The rectal administration of ether in olive oil has proved to be extremely irritating and has therefore been abandoned. Repeated sessions of vigorous prostatic massage, as in the treatment of gonococcal prostatitis, may cause proctitis, and habitual rectal coitus will almost certainly induce the mucosal changes of chronic proctitis. Trauma of the mucosa and resulting proctitis occur in chronic prolapsing piles of the third degree and in any degree of recurring prolapse of the rectum. Intestinal worms may cause some degree of proctitis, and the presence of ova of *Schistosoma japonicum* in the rectal wall is accompanied by an intense proctitis. The rectal mucosa is extremely sensitive to radium, and proctitis is common after radium needling for carcinoma of the rectum and the vaginal insertion of radium applicators to the cervix uteri (see p. 531).

Prostatic massage and sodomy

Prolapse of piles or rectum

Parasites

Radium

Neighbouring acute inflammation

The discharge of pus into the rectum is irritating, and proctitis always accompanies the rupture of a pelvic abscess into the rectum. The proximity of an acute inflammatory lesion, such as a submucous abscess, causes proctitis, and a post-operative ulceration of the anal canal, such as occasionally follows haemorrhoidectomy, is liable to extend up into the lower rectum and cause a very intractable type of proctitis. Proctitis is also common in the recto-sigmoid region in association with an acute diverticulitis of the pelvic colon.

Specific infections

Among specific types of proctitis are those due to bacillary and amoebic dysentery and tuberculous infection. Acute gonococcal proctitis occurs in both sexes from rectal coitus; in females with gonorrhoeal cervicitis or urethritis the rectum may be infected by direct extension. The primary chancre of syphilis and the primary ulcers of chancroid and of lymphopathia venereum may also occur in the rectum with an accompanying proctitis and are caused by direct infection.

Morbid anatomy and bacteriology

Acute proctitis

Acute catarrhal proctitis shows hyperaemia and oedema of the mucosa, due to a vasodilatation, and inflammatory exudate in the mucous and submucous layers; there may be small punctate haemorrhages, small superficial erosions, or actual ulcers.

Chronic proctitis

As the proctitis becomes more chronic, the mucosa is thickened, and there may be a general diminution in the lumen of the rectum which can be felt digitally. Usually the intestinal glands (crypts of Lieberkühn) become deeper and more active, with excessive production of mucus (hypertrophic form), but more rarely the mucosa is thinned, atrophied, and dry (atrophic form); this occurs particularly in senile and dehydrated subjects who have long had chronic constipation.

Bacteriology

Bacteriological examination of the discharge from a catarrhal proctitis often shows that there is no departure from the normal intestinal flora. Sometimes there is an excess of streptococci, and the growth of haemolytic *Bact. coli* and streptococci on culture should be specially noted. The importance of the Gram-positive diplococcus described by Bargen is not yet settled, but the general opinion among pathologists is that it is not specific; it is found in many healthy subjects as well as in those with procto-colitis, and it may be merely a variant form of streptococcus.

Dysenteric proctitis: bacillary

The morbid anatomy of proctitis which is part of a bacillary dysenteric infection is that of an acute purulent proctitis with irregular superficial ulcers which bleed very readily. For the various dysentery bacilli see DYSENTERY, BACILLARY, Vol. IV, p. 321.

Amoebic

In amoebic dysentery the characteristic feature is the formation of small elevations in the rectal mucosa; these break down to form round or oval ulcers, which have a greyish base and clean-cut discrete margins round which there is a narrow zone of hyperaemia; the mucosa between the ulcers is pale and almost normal. For the detection and characters of cysts of *Entamoeba histolytica* see AMOEBIASIS, Vol. I, pp. 367 and 371.

Tuberculous proctitis

Tuberculous proctitis usually occurs in association with active pulmonary tuberculosis. A tuberculous submucous abscess develops in the rectal wall, and, when it ruptures into the lower rectum, one or more irregular ulcers with indolent undermined margins are left; the type of proctitis may be indicated by the presence of characteristic tuberculous ulceration at the anus or of non-indurated sinuses discharging externally to the anal margin. A nodular hypertrophic type of tuberculous proctitis has been seen, apparently as a direct extension through the anterior rectal wall at the bottom of the recto-uterine excavation (pouch of Douglas), and is secondary to tuberculous peritonitis or tuberculosis of the uterine (Fallopian) tubes.

Gonococcal proctitis

Gonococcal infection of the rectum produces an acute proctitis with a bright red velvety hyperaemia of the mucosa. The pus has a thick creamy appearance, and Gram-negative intracellular diplococci are readily found in the acute stage, though precise diagnosis by smear is much more difficult when the condition has become more chronic. Infection of the anal crypts is prone to occur.

Proctitis with specific ulcers

So far as is known at present, the proctitis associated with primary venereal ulcers has no characteristic appearance. In any anomalous case the possibility of infection with syphilis, chancroid, and or lymphopathia venereum should be kept in mind; in regard to the last named, the size, appearance, and duration of the ulcer, when the rectum is primarily infected, are not precisely known, and a Frei's test should accordingly be done in a suspected case (see Vol. VIII, p. 298).

Clinical picture

Acute proctitis

An acute catarrhal inflammation of the rectum, when viewed through a proctoscope and sigmoidoscope, gives an appearance which is well described by the term 'acute granular proctitis'. The hyperaemic mucosa is bright red or pink and appears thickened and granular on the surface, and the usual shiny appearance, with a capillary network on a pale background, is lost. Small petechial haemorrhages may be visible; in some cases this is very prominent, particularly in young female adults, so that the mucosa has a red spongy surface which oozes blood freely; this was formerly called acute haemorrhagic proctitis, but it is probably only a severe granular proctitis.

Acute proctitis with ulceration

Ulcers if visible are usually small, superficial, oval, and arranged with their long axis in the longitudinal direction of the bowel, particularly in the anterior rectal wall. Proctitis of this degree is almost invariably associated with a similar condition in the pelvic colon or throughout the entire colon, i.e. it is a generalized ulcerative colitis. In the acute stage a small amount of fluid faeces mixed with blood, mucus, and pus is seen in the rectum or running down from above; an extremely offensive smell is characteristic of the discharge.

Digital examination

Digital examination at this stage shows that the lumen of the rectum is diminished and its walls thickened. Sigmoidoscopically the narrowed lumen of the rectum, particularly in the recto-sigmoid region, is very characteristic and is due chiefly to spasm of the muscular walls together with oedema and inflammatory thickening of the mucous and submucous layers. Digital and instrumental examination causes a good deal of pain and distress, with an urge to expel the instrument.

Chronic proctitis

In chronic proctitis the mucosa remains thickened, dull, and partly obscured by adherent lymph; when touched with an instrument or swab it bleeds. The discharge, which is free in the lumen of the bowel, varies greatly even in the same patient from week to week: on some occasions it may be thick and obviously purulent, on others more mucoid. The amount of blood exuded into the bowel lumen is also variable: there may be a considerable amount, or only a little dark blood lying on the mucosa; at other times blood may be absent until the mucosa is touched. At this stage well formed or even constipated faeces may be seen in the upper part of the rectum.

Symptoms

The symptoms of acute proctitis are chiefly tenesmus, with a feeling of fullness and weight in the rectum. The patient has an intense urge to defaecate, but the amount of faeces passed is small, and often only a little blood and mucus is voided.

General symptoms, such as malaise and vague aching pains in the body, may be experienced. The temperature may be slightly raised, but often the proctitis has no general effect, and in spite of a very angry-looking rectal mucosa, as seen on proctoscopy, the patient appears to be in excellent health. In the haemorrhagic types, however, an alarming amount of blood is lost, and a secondary anaemia develops rapidly, with lassitude, prostration, and a dirty tongue.

If the recto-sigmoid region is affected, there is lower abdominal pain, especially before and during the bowel movements, and pain in the back. Diarrhoea is the chief symptom, the actions mounting up to 10 or 12 in twenty-four hours. The irritability of the rectum is usually most pronounced in the mornings and no doubt is due to the collection of blood and pus in the rectum during sleep. Abdominal examination usually shows spasm and tenderness of the iliac and pelvic colon. Irritability of the bladder and difficulty in micturition may also occur. The anus is irritated by the rectal discharge, and the frequent straining at stool is liable to produce very painful anal fissures.

Course and prognosis

A mild attack of acute simple proctitis usually subsides readily with rest in bed for a suitable period with proper general management and avoidance or removal of any exciting factors. If the proctitis is part of a generalized granular or ulcerative colitis, the prognosis is more uncertain, the condition often being resistant to treatment and prone to relapse. The same rather doubtful prognosis applies to cases of chronic proctitis, in which there is probably some underlying general cause which is difficult to discover; resolution and return to normal are likely to be tedious.

Diagnosis and differential diagnosis

Proctitis

The clinical picture of a simple proctitis as shown by proctoscopy is characteristic. The diagnosis consists largely in defining the extent and degree of the inflammation and the specific type of proctitis. Procto-colitis is indicated by the severity of the symptoms and by the sigmoidoscopic view of inflammation extending high up, with blood and discharge coming down from the pelvic colon. Procto-colitis of this type in an elderly person should raise the question of diverticulitis, and a barium sulphate enema examination in the quiescent stage is advisable.

Procto-colitis

Diagnosis from carcinoma

The differential diagnosis from carcinoma of the rectum must always be considered. A discharge of blood and mucus is not sufficient to justify a diagnosis of colitis or proctitis until a thorough routine examination has been made and, although the mucosa below a carcinoma of the rectum is usually pale, this is not always the case; proctitis in the lower rectum may occasionally be associated with a carcinoma in the recto-sigmoid region, and this undoubtedly is a very difficult diagnostic problem.

Tuberculosis

Tuberculosis of the rectum with an associated proctitis can sometimes be diagnosed by biopsy and recognition of tubercles in the granulation tissue. Confirmatory evidence is the clinical and radiological diagnosis of pulmonary tuberculosis or the presence of well marked signs of abdominal tuberculosis.

Amoebiasis

Every effort must be made to detect specific infections, particularly amoebiasis. The tendency of amoebic dysentery to flare up after a long interval should be borne in mind, and the stools should be examined by a pathologist. The occasional development of an amoebic granuloma in the rectal wall is now recognized and must be distinguished from a carcinoma (Yeomans).

Bacillary dysentery

The cultural and agglutination tests for bacillary dysentery and allied infections, e.g. Flexner, Shiga, Sonne, and Morgan, should be undertaken in all cases of acute procto-colitis.

Gonococcal proctitis

Gonococcal proctitis should be suspected when an acute proctitis is found in the lower rectum, especially when thick creamy pus is present and is observed to be expressed from the region of the anal crypts as the proctoscope is withdrawn. Both smears and cultures should be made (see Clements and Hughes). In the diagnosis of proctitis in children cultures for gonococci are important, and in all chronic cases the complement-fixation test may be invaluable.

Other venereal infections

In proctitis associated with an anomalous ulcer, which may be situated in the rectum or anal canal, the possibility of a venereal infection must be kept prominently in mind; the ulcer may be small and easily missed. A chancroid infection is readily diagnosed by the intradermal (dmelcos) reaction (see Vol. III, p. 100). A primary syphilitic chancre gives a positive Wassermann reaction very early and disappears in a dramatic fashion on antisyphilitic treatment. The proctitis caused by lymphopathia venereum, whether in the stage of a primary ulcer in the rectum or the proctitis due to lymphatic obstruction, can be diagnosed with certainty only by a positive Frei test; negative confirmation is found in failure to respond to antisyphilitic treatment.

Treatment

Preventive

Some of the causes of proctitis, such as faecal impaction, excessive purgation, and enema injury, can be obviated, and individuals who know that they are subject to proctitis can do much to prevent attacks by careful diet and avoidance of constipation, chills, and overwork.

Diet

Rest in bed for an adequate period is essential. The diet should be light and easily digested; roughage should be excluded. Fish and white meats are allowed. Small doses of liquid paraffin should be given regularly during or after meals, say one dessertspoonful thrice daily.

Kaolin and charcoal

Treatment of anaemia

Kaolin may be given two or three times daily; charcoal is sometimes prescribed also. If the patient is nervous and highly-strung, phenobarbitone or prominal will prove helpful. When there is considerable loss of blood, iron should be given orally (Blaud's pill, or iron and ammonium citrate). Blood transfusion is occasionally advisable in acute haemorrhagic procto-colitis.

Local treatment

Locally, the rectal mucosa may be swabbed on alternate days, through a proctoscope, with a 2 per cent aqueous solution of mercurochrome, and each night a suppository containing 2 per cent of mercurochrome should be inserted.

Oil injections

To protect and lubricate the rectal mucosa as well as to soften any faecal matter, 3 to 5 fluid ounces of warm olive oil should be injected into the rectum at night and retained, if possible, until the morning. In the treatment of ulcerative colitis Russell Best has found benefit from daily instillation of 2 to 4 fluid ounces of cod-liver oil into the rectum, and this might well be tried in cases of proctitis. For excessive rectal irritability a 5 per cent suspension of bismuth subgallate in olive oil (5 fluid ounces) is run into the rectum once or twice in twenty-four hours, or, alternatively, starch and opium enemas may give relief in the acute stage.

Starch and opium enemas

Specific treatment

For the treatment of specific types of proctitis reference should be made to the following titles: DYSENTERY, BACILLARY, Vol. IV, p. 338; GONORRHOEA, Vol. VI, p. 27; LYMPHOPATHIA VENEREUM, Vol. VIII, p. 300; and SYPHILIS.

In gonococcal proctitis the rectal infection usually clears up readily with irrigations of potassium permanganate (1 in 4,000), or acriflavine (1 in 5,000) which Clements and Hughes prefer. Local applications should be made to the rectal mucosa, through a tubular proctoscope, of 10 per cent aqueous solution of mercurochrome or of silver preparations such as silver protein (protargol) or mild silver protein (argyrol). General treatment by administration of sulphanilamide may give dramatic results.

Surgical treatment

Surgical treatment is rarely needed except for local complications, such as thrombotic external piles and fissures. A peri-anal or ischiorectal abscess is not an unusual complication of gonococcal proctitis and is due to infection of the anal crypts; the usual external incision for drainage is required, and a second-stage operation at a later date is often necessary.

Appendicostomy

Appendicostomy is a valuable operation in tuberculous proctitis; when a satisfactory opening into the appendix has been established, a few ounces of warmed olive oil or cod-liver oil are run into the caecum through a tapered rubber appendicostomy catheter every evening; this considerably reduces the rectal symptoms and therefore aids the general treatment of the patient.

8.–STRICTURE

Aetiology

Lymphopathia venereum

1353.] The causation of diffuse inflammatory stricture of the rectum has been greatly clarified in recent years by the recognition of the importance of lymphopathia venereum. These strictures were formerly ascribed to syphilis, tuberculosis, or gonorrhoea. In 1928, however, Frei and Koppel obtained a positive intracutaneous reaction in five cases of rectal stricture, and this most important observation has been confirmed by numerous workers all over the world. It is now believed that the vast majority of diffuse rectal strictures are due to infection with lymphopathia venereum; if other venereal infections, such as gonorrhoea or chancroids, are present in the rectum they should be considered as superadded infections which do not play any part in the production of stricture.

Syphilis

Even if patients with rectal strictures exhibit clinical or serological evidence of syphilis, it is unlikely that the stricture is syphilitic; Bensaude and Lambling give a number of excellent reasons against the view that syphilis causes rectal strictures. It is now doubtful if strictures occur from tuberculosis or dysentery. These infections may precede or follow lymphopathia venereum without causing stricture.

Tuberculosis and dysentery

Multiple strictures of the colon and rectum are prone to develop in the late stages of ulcerative colitis. The rectal strictures tend to be of the diaphragmatic type and may be felt as low down as the ampulla of the rectum. Here again, however, the distinction from lymphopathia venereum is obscure, and in all such cases a Frei's test should be done; Whittaker published two cases of chronic ulcerative colitis, of eight and two years' duration respectively, with rectal strictures in which ultimately Frei's test was positive.

Ulcerative colitis

Gunshot and other severe injuries of the rectum are liable when healing to result in strictures. Similarly any injury causing sloughing of the rectum, e.g. injection of corrosive solutions in mistake for enemas and rectal scalds from administration of too hot enemas, may cause stricture. Localized sloughing of the rectal wall, followed by a stricture, has been caused by prolonged impaction of the foetal head in the maternal pelvis.

Injury

A curious type of rectal stricture following treatment of haemorrhoids by submucous injections of phenol in oil was described by Rosser who ascribed the strictures and submucosal tumefaction to the use of cotton-seed oil and liquid paraffin as the vehicle for the injection.

After submucous injection

Operations involving incision and suture of the rectal wall may cause strictures. For instance, the removal of a villous tumour of the rectum through the rectal lumen or by posterior proctotomy may result in a stricture, partly from immediate narrowing of the lumen by the sutures and partly by scar contraction. Any type of conservative resection of the rectum, whether of the sacral sleeve type or the abdomino-anal, may be followed by a troublesome stricture, and amputation of the rectum for complete prolapse sometimes has the same tendency.

Post-operative

A tubular stricture of the rectum with a peculiar dense periproctitis may follow the treatment of carcinoma of the cervix uteri by radium. Todd considers that the usual cause is accidental local overdosage due to slipping of the radium applicators, or retroversion which allows an intra-uterine applicator to press against the rectum.

Radium

Morbid anatomy

The morbid anatomy of rectal stricture due to lymphopathia venereum has already been described (see Vol. VIII, p. 292). In females the deep pelvic lymphangitis which precedes the rectal stricture is secondary to a primary lesion in the vagina. In males the rectal stricture points to a primary infection in the rectum; Bensaude and Lambling stated that 80 per cent of males with strictures confessed to the practice of sodomy, and proctitis in them is frequent, whereas in females it is rare. In both sexes the peri-rectal lymphangitis is accompanied by a massive inflammatory reaction, the organization of which produces the rectal stricture; this is seen at its maximum in negroes, in whom the 'fibro-plastic diathesis' described by Rosser is a racial characteristic; in them the

Lymphopathia venereum

formation of genito-anal elephantiasis and keloids is a prominent complication. Multiple peri-rectal abscesses and fistulae are commonly associated with rectal strictures due to lymphopathia venereum.

Radium stricture

The submucous and peri-rectal fibrosis which may follow an overdosage of radium is believed to be due to a diffuse endarteritis of the rectal wall, chiefly at the level of the cervix uteri; the anastomosis between the terminal straight branches of the superior haemorrhoidal artery in the rectal ampulla is poor, and this part of the rectum is consequently extremely sensitive to vascular occlusion; hence the fibrosis of the rectal wall with ulceration and necrosis of the mucous membrane; it may develop between 6 and 12 months after the exposure to radium.

Injury and post-operative stricture

In rectal strictures due to injury or burns the contraction is due to scar tissue and its extent depends on the severity of the injury. Certain strictures, however, such as those which develop after a conservative resection of the rectum, tend to be very intractable if the rectum is temporarily put out of action by a colostomy; for this reason it is advisable to close these temporary colostomies as soon as possible after the rectal anastomosis has healed satisfactorily, and thus get the advantage of the dilatation due to the passage of normal stools.

Clinical picture

Difficulty in defaecation

The symptoms are usually progressive. The patient complains of difficulty in evacuating the bowels, and the motions have to be kept very loose. In stricture in the lower part of the rectum, small 'pipe-stem' motions may be observed when the stools are formed. Irritability of the rectum is caused by incomplete evacuation; and faecal impaction, sometimes amounting to subacute intestinal obstruction, may occur above a tight rectal stricture; stercoral ulceration is a source of danger, either from spontaneous perforation or from perforation caused by the passage of dilators.

Bleeding and discharge

Bleeding and discharge are due to an associated proctitis, which is maximal in strictures due to lymphopathia venereum and to chronic ulcerative colitis. Peri-anal fistulae increase the local discharge, and faecal leakage may be caused by a patulous sphincter or the formation of a recto-vaginal fistula.

Constitutional symptoms

Constitutional symptoms, such as lassitude, anaemia, and loss of weight, due no doubt to prolonged pain and suppuration, are common. The numerous general symptoms of lymphopathia venereum have been fully described in the article on that disease (see Vol. VIII, p. 295).

Diagnosis

Digital examination

A post-operative smooth fibrous stricture may produce very slight symptoms; by taking large doses of liquid paraffin and aperients the patient can pass watery stools through a stricture with a calibre which would scarcely admit a little finger, and the presence of a stricture may in consequence be unsuspected and missed if the rectum is not carefully examined. A stricture is best assessed by digital examination. The type of stricture, whether tubular or diaphragmatic, can be appreciated, and whether it is associated with much peri-rectal fibrosis. A recent stricture may be felt as elastic and likely to yield to dilatation, or it may give the impression of being densely fibrous. The amount of blood and pus on the examining finger will give an estimate of the accompanying proctitis. A patulous sphincter is common with a severe rectal stricture and can be felt by the finger.

Sigmoidoscopy

As a rule the adult-sized sigmoidoscope will not pass through a stricture of the rectum; a child's sigmoidoscope with an external diameter of $\frac{5}{8}$ inch, or Morgan's and Officer's pattern (see Fig. 47), which has an external diameter of $\frac{1}{2}$ inch, may be used and often gives valuable information about the length of the stricture and the appearance of the mucous membrane above it; polypi and ulceration should specially be noted.

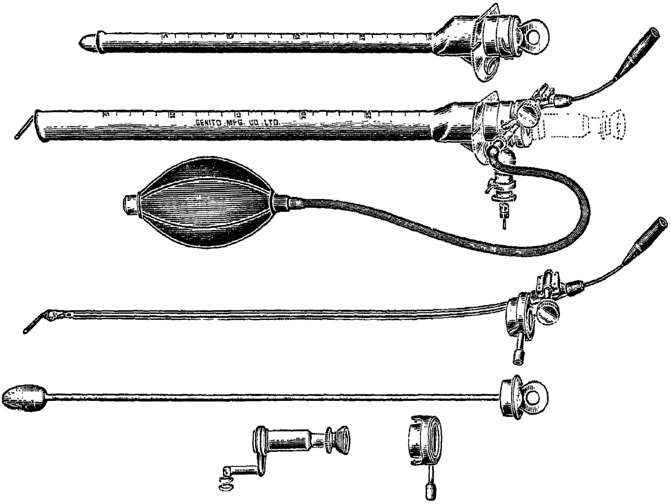

FIG. 47.—C. Naunton Morgan's and R. Officer's sigmoidoscope. The smaller tube is 25 cm. in length and is obtainable in external diameters of $\frac{1}{2}$ and $\frac{5}{8}$ inch

Barium enema

A barium sulphate enema examination is advisable in some cases, when multiple strictures are suspected. The diffuse rectal stricture due to lymphopathia venereum is sufficiently characteristic to be recognized immediately or at least suspected in patients either of white or coloured races. In Europe the disease is on the increase, and the diagnosis should be readily confirmed by means of a Frei's test (see Vol. VIII, p. 298).

Frei's test

Multiple venereal infections

In chronic ulcerative colitis the possibility that strictures are due to lymphopathia venereum must be kept in mind. Stricture secondary to application of radium to the cervix will be diagnosed by the history of the previous treatment in conjunction with rectal and vaginal examination. Stricture resulting from pelvic cellulitis of uterine or prostatic origin is no doubt rare, but in all such cases the possibility of lymphopathia venereum must be kept in mind.

Radium

Cellulitis

Actinomycosis Actinomycosis involving the rectum is a rare chronic inflammatory infection, characterized by the formation of a submucosal mass with some constriction of the rectal lumen; the mucosa is thrown into indurated ridges. Such an infection extends gradually down to the buttocks, where a large fixed mass is formed, the chief characteristic being a brawny induration, with discoloration of the skin and formation of multiple sinuses through which necrotic debris is discharged. The typical granules of actinomycosis will in due course be discoverable in the pus, although repeated examination of the discharge may be necessary.

Malignant stricture A diffuse malignant stricture of the rectum is sometimes a source of difficulty in diagnosis and may be due to a sarcoma, endothelioma, or a grade 4 carcinoma. The general symptoms are invariably very severe, with a grave loss of weight and strength. Rectal examination is likely to be extremely painful, and one point of clinical significance is the unusually free bleeding produced by digital or instrumental examination of the rectum (Grey Turner). Examination should invariably be carried out under anaesthesia, the removal of material for biopsy being the primary object.

Endometriosis The differential diagnosis also involves consideration of endometriosis (see Vol. IV, p. 571). The recto-sigmoid may become invaded from without by endometrial tumours, the characteristic feature being that the patients are women, usually between the age of thirty and the menopause; their general health is not impaired, and the chief complaints are increasing constipation, lower abdominal pain aggravated at the time of the menstrual periods, and a vague deep-seated rectal pain. Although the recto-sigmoid may become much narrowed, the invasion is limited to the outer coats of the bowel, and the mucosa is not usually affected. Endometriosis should be suspected when the clinical points mentioned above are present, and when bimanual rectal examination reveals an acutely tender lesion in the pelvis; endometrial masses in the rectovaginal septum are strongly confirmatory.

Treatment

(i) *Preventive*

Strictures following rectal operations or injuries can in many cases be prevented from advancing to a serious degree by careful supervision in the post-operative period. Regular digital examination is required, and Hegar's dilators should be passed in order to maintain the lumen of the rectum at a diameter of one inch until the scar has ceased to contract. The same method of anticipating stricture formation is needed in those cases of ulcerative colitis in which a tendency to stenosis has been noted.

(ii) *Surgical*

Internal proctotomy Tight fibrous strictures of the rectum, when of the linear or diaphragmatic as opposed to the tubular type, are suitably treated by internal proctotomy and dilatation.

Under general or low spinal anaesthesia a forefinger is passed through the stricture, and the posterior half of its circumference is incised superficially in several places by means of a blunt-ended bistoury. A series of graduated Hegar's dilators are then passed up to the maximal size 25/26. Haemorrhage is controlled by irrigation with hot saline, solution of hamamelis, or silver nitrate solution; a large-bore rubber tube is passed through the stricture and is fixed to the dressings externally by tapes or a safety-pin. The tube is left in the rectum for 24 to 48 hours, and after its removal the rectum is kept clean by irrigation through a proctoscope; Hegar's dilators are passed daily at first and then at gradually increasing intervals.

Plastic operations

Plastic operations have been attempted in some cases. For instance Lockhart-Mummery and Lloyd-Davies described a case treated as in pyloroplasty by incision of the stricture longitudinally, followed by transverse suture of the rectal wall. Jelks advocated division of the fibrous tissue stenosing the rectum by incising it from without, a finger being passed into the rectum as a guide.

Excision of rectum

Excision of the rectum for inflammatory stricture is now discredited. On account of the massive peri-rectal fibrosis and adhesions it has been found technically impossible to perform a satisfactory excision, and the results, as reported by Gatellier and Weiss, do not encourage this major operation. Superadded carcinoma, however, would be a sound indication for radical excision of the rectum. Colostomy is required (i) if an acute or subacute intestinal obstruction has been caused by a stricture, (ii) if the stricture is too high or too extensive to be relieved by dilatation, and (iii) if fever or severe bleeding, discharge, and pain are repeatedly caused by dilatation. In these circumstances a colostomy will certainly give much relief and is likely to be a permanency.

Colostomy

Pre-sacral neurectomy

In the treatment of radium strictures of the rectum accompanied by severe pain Todd recommended a pre-sacral neurectomy, which has proved helpful in relieving pain and promoting healing of the rectal ulceration.

Diathermy

For strictures due to lymphopathia venereum probably the best treatment is the combination of dilatation and diathermy, as advocated by Bensaude and Marchand. The method consists in passing a metal dilator ¼ to 1 inch in diameter, the size which is gripped tightly by the stricture being selected. The wire from the diathermy machine is attached by means of a metal collar or screw attachment; the indifferent electrode is applied firmly to the sacrum, with a folded towel or pad moistened in saline solution intervening between the plate and the patient's skin. The current is switched on, the strength being sufficient to give the patient a feeling of bearable heat. The sessions last for twenty minutes and are given three times a week for twelve weeks followed by an interval for rest during which finger or instrumental dilatation is continued once a week. The local heat produced by diathermy may destroy the active virus of lymphopathia venereum if still present in the rectum and promote revitalization of scar tissue. Frankfeldt considers that short-wave diathermy is preferable to ordinary diathermy, for it has a distinct bactericidal action which soon reduces the amount of discharge, and a progressive dilatation of the stricture can usually be assured. (See ELECTROTHERAPY, Vol. IV, p. 501.)

(iii) *Symptomatic*

The symptomatic treatment consists in regulating the bowels, usually by administration of liquid paraffin, and in keeping the rectum as free from discharge as possible; rectal wash-outs of saline solution, bicarbonate lotion, aqueous flavine 1 in 5,000, or mercurochrome 1 in 4,000 are all suitable and may be given through a proctoscope or a two-way catheter. Iodides may be given orally, or, if secondary anaemia is prominent, some preparation of iron should be administered. For the drug and vaccine therapy for strictures due to lymphopathia venereum see Vol. VIII, p. 301.

9.–BENIGN TUMOURS

Epithelial

1354.] The chief interest in benign tumours of the rectum is centred upon the epithelial tumours, adenoma and papilloma. The adenomatous tumours or polypi are common and are important because of their well established tendency to undergo malignant change; not infrequently they are multiple, which is important not only from the diagnostic point of view but also in regard to treatment.

Connective tissue

Benign connective-tissue tumours are much less common and, except fibroma or fibrous polypus of the anal canal, are rare.

Aetiology

Age incidence

In children a solitary adenoma not larger than a small cherry is a fairly common source of rectal bleeding; a small sessile or pedunculated lymphoma may also occur, but with these exceptions benign rectal tumours are more usually found in adult life.

In the vast majority no aetiological factor, such as sex, occupation, nationality, or previous history, can be shown, but in some instances, notably in connexion with polyposis, the importance of heredity is now established.

Polyposis intestini

Certain cases of multiple adenomas are familial; the tendency to develop polypi in the colon and rectum is inherited as a Mendelian dominant (Cockayne); it is transmitted by the father or mother and can be inherited by children of both sexes. This disease is now known as polyposis intestini. The polypi appear and gradually cause symptoms at any age between puberty and forty years. The pedigree charts of polyposis families show an abnormally high incidence of cancer of the colon and rectum; the members tend to be short-lived and the families to die out.

Acquired polyposis

Multiple adenomas also occur as an acquired condition in patients without any family history of the disease; it is debated if in these cases constipation and the irritation from hard faecal masses, particularly in the iliac and pelvic colon, should be considered of aetiological importance.

Polyposis in inflammatory conditions

In many chronic inflammatory conditions, such as ulcerative colitis, dysentery, tuberculosis, and the ulceration which may occur above a rectal stricture, polypi are prone to occur. At first they are granulomas or loose tags of mucous membrane, but as healing proceeds they become isolated, retention cysts may form in them, and ultimately true polypi may develop. In 693 cases of chronic ulcerative colitis Bargen showed that 10 per cent eventually became complicated by multiple polypi.

Inclusion cysts

Inclusion cysts of the rectal wall occur exclusively after a previous operation involving cutting into or suturing the wall of the rectum or anal canal. Presumably in these cases a small portion of columnar epithelium becomes misplaced or buried beneath the rectal mucosa or granulations, and later the mucus-producing glands become active, and a submucous cyst is produced.

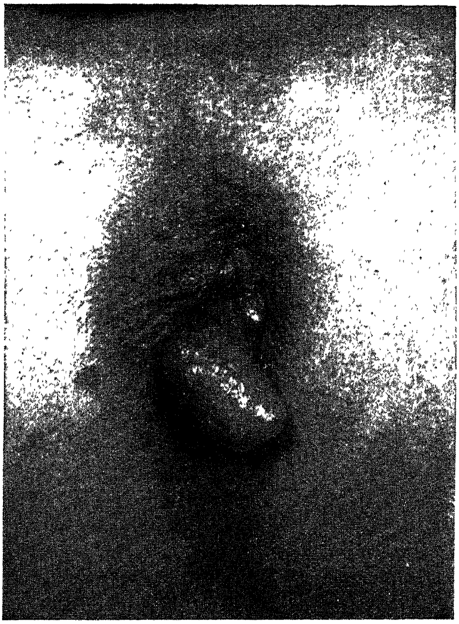

FIG. 48.—Fibrous polyp in connexion with right posterior pile

Fibroma

The fibroma or fibroid polypus of the anal canal is a sequel to thrombosis in a large internal haemorrhoid. The right posterior pile is commonly affected (see Fig. 48), but occasionally all three primary internal piles may be converted into fibrous polypi. These tumours may also originate in anal papillae which become hypertrophied; polypi of this type are smaller than that depicted in Fig. 48 and may be found at any point in the circumference of the anal canal.

Morbid anatomy

Adenomas Adenomas of the rectum arise in the mucous membrane, from the intestinal glands (crypts of Lieberkühn), as small outgrowths which are at first sessile and later pedunculated. Their size varies between that of a pea and that of a strawberry; only rarely are they larger, and then malignant change will almost certainly have taken place. Small adenomas may be pale, but larger ones are usually bright pink or deep red; their surface is slightly lobulated and may become inflamed and ulcerated.

Histological classification Histologically, polypi have been divided by Fitzgibbon and Rankin into three groups. In group 1 the polypi are small, pedunculated, and composed of normal epithelium, with absence of branching; these are likely to remain innocent for an indefinite time. In group 2 the epithelium is more varied and more irregular, with less production of mucus. The nuclei stain deeply, and active proliferation of epithelium is evident. All the large rectal adenomas fall into this group, and areas of adenocarcinoma are relatively common, although serial sections may be needed to prove it. In group 3 the epithelium is of an extremely cellular undifferentiated type; the tumours remain sessile and fail to grow larger than 6 to 8 mm. before developing into frank carcinomas.

Papilloma A papilloma or villous tumour of the rectum is by no means rare and occurs in adults, 85 per cent being over the age of 45 (Lambling). It is a soft sessile tumour which in the course of its slow growth may occupy a large area of the rectal wall. Arising in the intestinal epithelium the tumours gradually become more raised and warty in their central portions, although the outlying parts may be low and soft. Microscopically a papilloma consists of villous processes of various lengths which in entirely benign cases are superficial, without any evidence of infiltration into the submucous layer or penetration of the muscularis mucosae.

Dermoids The true rectal dermoid which has been found in the lumen of the rectum is excessively rare (Bland-Sutton; Fried and Stone), and its first sign may be the protrusion of hair from the anus. Post-rectal or sacro-coccygeal teratomas are rare tumours in the hollow of the sacrum, containing sebaceous material, hair, and teeth. *Lipoma* A submucous lipoma of the rectum is a rare pedunculated tumour composed of adipose tissue and covered with mucous membrane. *Myoma* Myoma of the rectal wall is a benign tumour composed of unstriped muscle (leiomyoma); usually sessile, this tumour tends gradually either to project into the lumen of the rectum or to extend outwards into the peri-rectal tissues.

Lymphoma Lymphoma is found as a sessile or pedunculated tumour in the rectum and may occur at any age; it is usually small and is not likely to be correctly diagnosed except by microscopical examination.

Other tumours The remainder of the benign tumours, myxoma, glioma, and angioma, are extremely rare, and only a few examples are found in the literature.

Clinical picture

Clinical examination The clinical characters of benign rectal tumours are assessed by routine examination, digital examination, proctoscopy, and sigmoidoscopy. The situation and size of a tumour and whether it is sessile or pedunculated are readily ascertainable. The surface of a tumour may be smooth and soft, or it may be hard, ulcerated, and extremely friable, so that free bleeding is caused by examination. Villous tumours offer some difficulties in diagnosis owing to their size and the softness of the outlying portions, so that care is needed in forming a clinical estimate of their size.

Suspicion of malignant change should be aroused if a tumour has become palpably indurated either at its base or in its substance; if this is combined with surface ulceration and a recent exacerbation of symptoms, the likelihood of malignancy is still greater. Pre-operative histological confirmation of malignancy is sometimes possible by removing portions of the tumour through a proctoscope or sigmoidoscope by means of Brünings's or some other type of punch forceps.

The presence of multiple adenomas can sometimes be appreciated digitally and is confirmed by proctoscopy and sigmoidoscopy, by which means the number and size of the polypi are noted, together with any evidence of ulceration.

Symptoms The symptoms of a benign tumour are extremely variable; in some cases a small adenoma of the rectum does not produce any symptoms and is discovered in the course of a proctoscopic examination.

Bleeding Bleeding from the rectum, however, is the commonest symptom and occurs with both sessile and pedunculated tumours. The surface of an adenoma is liable to become damaged or ulcerated, especially if the tumour is sufficiently low in position or has a long pedicle which allows it to become caught in the anal canal or even extruded from the anus. Bleeding may also occur from a rectal lymphoma, myoma, or lipoma and is the chief symptom of an angioma of the rectum.

Discharge A discharge of mucus is produced by secretion from the tumour or by irritation of the neighbouring mucosa. A profuse discharge of clear jelly-like mucus is the characteristic symptom of a villous tumour.

Prolapse from rectum Prolapse from the rectum occurs if a tumour has a sufficiently long pedicle and when a rectal adenoma or papilloma has arisen in the lower part of the rectum. Prolapse is the chief symptom of a fibrous polypus of the anal canal and is also associated with anal pain. *Diarrhoea* Diarrhoea is the result of rectal irritation from a polyp and is seen at its maximum in cases of large villous tumour and of polyposis. *Abdominal pain* Lower abdominal pain may be caused by spasm of the recto-sigmoid when a polyp is present in this region, or it may be due to recurring attacks of pelvi-rectal intussusception.

Anaemia General symptoms may be negligible, but in some cases secondary anaemia may be caused by repeated rectal bleeding. A large villous tumour is liable to cause much loss of strength as the result of diarrhoea and sleeplessness.

Course and prognosis

In some instances, such as the group 1 adenoma, lymphoma, lipoma, and fibroma, the course may extend over many years with merely a slight increase in the symptoms corresponding to the increase in size of the tumour or the length of its pedicle.

Onset of malignancy

Too often, however, the course of the disease is abruptly altered by the onset of malignant change. In adenomas of group 2 a carcinoma is almost certain to supervene in the course of a few years, and it is rare to find an adenoma with a diameter of more than 1½ inches in which carcinomatous change is not present. The longer the pedicle the better the prognosis, for there is less chance of malignant invasion of the bowel wall. It seems certain that most papillomas or villous tumours in the rectum remain benign for many years, so that they may reach a very large size without infiltration commencing. If carcinoma develops in these cases it is usually superficial and readily removed by radical operation, the specimens generally being grouped as A cases by Dukes' classification. In a series of 37 cases Lambling found that 18 were benign, 15 showed malignant changes, and 4 were from the onset of low-grade malignancy.

Polyposis

Perhaps the most difficult prognosis is that of polyposis, in which the family history, if indicating many deaths from rectal cancer, will be significant, together with the symptoms and age of the patient. Increasing bleeding and discharge from the rectum in a patient over 20 to 30 years of age with polyposis should be regarded as of serious import, probably indicating the need for major surgical treatment.

Connective-tissue tumours

The benign tumours of connective-tissue origin are of minor importance, except in the few recorded examples of an extensive angioma in which severe or fatal bleeding has taken place.

Diagnosis and differential diagnosis

Little difficulty is experienced in the diagnosis of these tumours except in the case of small sessile tumours, which must be differentiated from lymphoma and inclusion cyst.

Pedunculated tumours

Pedunculated tumours may have a range of up and down movement of several inches, so that a tumour felt and seen in the ampulla of the rectum may, on another occasion, be evident only on passing a sigmoidoscope to a higher level. In the same way it is possible for a polyp seen in the recto-sigmoid to originate in the pelvic colon and to descend to a lower level either by virtue of its pedicle or as the result of a slight intussusception.

Polyposis

Much care must be exercised in the diagnosis of polyposis. If much blood and pus are present in the rectum, the question must be considered whether the main condition is not one of ulcerative colitis or tuberculous disease of the colon, with multiple polypi or granulomas.

Radiography

A barium sulphate enema and X-ray investigation occasionally give additional help, for instance in the case of a polyp in the recto-sigmoid when spasm of the bowel prevents sigmoidoscopic access; in such cases the polyp may be shown by a filling defect, or its outline may be seen after evacuation and air-distension of the colon. The same method is used in all cases of suspected polyposis.

Diagnosis from inflammatory mass

A small inflammatory mass in the rectal wall, such as a fibrous nodule following a high submucous injection of phenol in oil, may simulate a benign tumour.

From bilharziasis

If the patient has resided in a country where bilharziasis is endemic, bilharzial infection of the rectum should be excluded. Excision and section of some of the rectal papillomas will quickly demonstrate the ova of *Schistosoma mansoni*, and examination of the urine and rectal discharge will also be confirmatory in an infected case (see also BILHARZIASIS, Vol. II, p. 329).

Treatment

Pedunculated tumours

Benign tumours should be removed surgically. Pedunculated tumours which can be brought down outside the anus (adenoma, lipoma, lymphoma) are easily dealt with by transfixion and ligation of the pedicle, followed by section of the pedicle with scissors or a diathermy knife (see Fig. 49).

Villous tumour

Villous tumours of the rectum are removed by local excision when fairly small or sometimes by a modified Whitehead method; in these cases it is absolutely necessary that a clear margin of at least $\frac{1}{4}$ inch of normal mucosa should be removed round the base of the tumour. A more radical operation is required if the tumour involves a large area of the rectal wall, and, according to the particular case and the height of the upper limit from the anus, it may be advisable to carry out a conservative type of resection (sacral or combined), a colostomy and perineal excision, or a combined excision of the rectum.

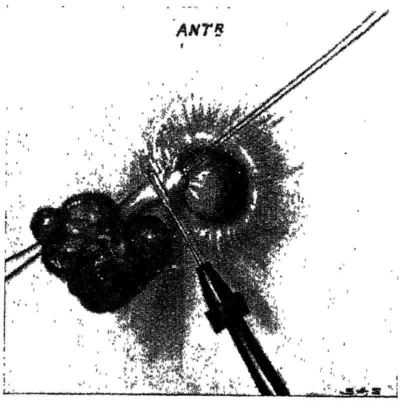

FIG. 49.—Local excision of pedunculated adenoma of rectum

Diathermy removal

Adenomas which cannot be delivered through the anus for local resection are readily removed by means of a diathermy snare or forceps. Frankfeldt's pattern (see Fig. 50; and Vol. IV, Fig. 128, p. 598), which can be fitted with a wire snare or a serrated forceps end, is a very handy instrument; it is made in three lengths (6, 12, and 14 inches) and can be used through any standard pattern of proctoscope or sigmoidoscope. Diathermy coagulation can also be applied to the rectal wall by means of a long insulated electrode; this is useful, for example, for coagulating the base of a tumour pedicle or for destroying small villous nodules which have recurred after a previous local operation. Diathermy, however, is not recommended as the primary method of removal of villous tumours, for they are usually too extensive, and a clean surgical excision is better.

Treatment of polyposis

The treatment of patients suffering from hereditary polyposis intestini requires careful consideration in each case. If the patients are young and the symptoms relatively slight, it will probably suffice to remove the polypi in the rectum and recto-sigmoid by diathermy; multiple sessions will be needed, and the patient must attend at regular intervals for review. If, however, the symptoms are increasing, the polypi being numerous and actively growing, the decision will most probably be to perform a total or subtotal colectomy. A total colectomy, the patient being left with a terminal ileostomy, is compatible with life; if, however, the rectum and recto-sigmoid can be cleared of polypi, this gives the patient the benefit of ultimate restoration of the intestinal continuity.

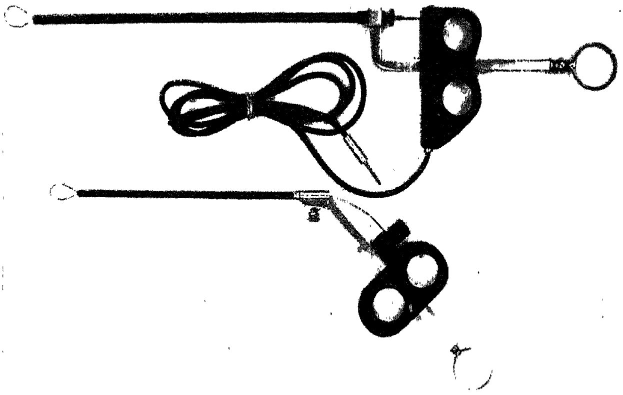

FIG. 50.—Two patterns of diathermy snare: Yeomans' (upper); Frankfeldt's (lower), fitted in this instance with a 6-inch insulated shaft

Colectomy

For polyposis with a superadded carcinoma in the rectum or recto-sigmoid radical excision of the rectum by the perineo-abdominal route is indicated, and at a later stage the remainder of the colon may be removed, even up to a terminal ileostomy if necessary.

In ulcerative colitis

In the treatment of severe ulcerative colitis complicated by polypi Rankin recommended a preliminary terminal ileostomy, followed by an interval of about three months for the patient to become restored to physiological equilibrium. Then a total colectomy is carried out in stages, and occasionally it may be possible to leave the rectal stump so that the ileum may be anastomosed to the rectum at a later date.

Myomas Myomas of the rectal wall are removed either from within the rectal lumen or by an extra-rectal approach according to which way the tumour is presenting. *Dermoids* Sacro-coccygeal dermoids are dissected out through a curved incision behind the anus; the coccyx is removed, and every effort is made to remove the cyst wall in its entirety; if previous suppuration has occurred this may be extremely difficult. *Implantation cysts* Implantation cysts are dissected out, and it would appear advisable to apply diathermy coagulation to destroy all the buried epithelium; one such case in which this was not done is known to have developed ultimately a columnar-celled carcinoma.

10.—CARCINOMA

Definition

1355.] A rectal cancer is commonly an adeno-carcinoma or columnar-celled carcinoma which arises in the mucous membrane. A sarcoma originating in the rectal wall is extremely rare.

For squamous-celled carcinoma of the anal canal and anus see ANUS DISEASES, Vol. I, p. 688.

Aetiology

Incidence Cancer of the rectum comprises about 3 to 4 per cent of all malignant tumours, and probably at least 60 per cent of cancers of the large intestine occur in the rectum and recto-sigmoid. *Situation of growth in the rectum* It is now generally agreed that 65 to 70 per cent of rectal cancers develop primarily in the upper third of the rectum; this is of much importance in diagnosis and treatment.

Sex There is a higher incidence of rectal carcinoma in males than in females, the proportion varying between 2 : 1 and 3 : 2. *Age* The commonest decade for carcinoma of the rectum is 50 to 60, but no age is exempt. Many cases have been recorded between the ages of 10 and 20, and patients between 70 and 80 often come for treatment. Rectal carcinoma is very rare under 10 years of age.

Pre-existing benign tumours Most rectal carcinomas are malignant from the start, and examination of even a small carcinoma usually shows no sign of any cause or reason for its development. Some, however, undoubtedly arise in a pre-existing benign tumour of epithelial origin, such as an adenoma or papilloma. Adenomas of group 2 tend inevitably to undergo malignant changes as they become larger; the change may develop at one or multiple places in the periphery of a polyp, and there may be some little interval before the base and pedicle of the polyp become invaded; this is important from a surgical point of view. Adenomas of group 3 become sessile and malignant very quickly. Villous tumours or papillomas also tend to become malignant (see Fig. 51); the change may take place at the centre or periphery and is usually a superficial type of cancer, often of grade 1 malignancy.

Other rectal lesions

Rarely lesions other than benign tumours may be of aetiological significance. The irritation at the internal openings of very chronic fistulae in ano appears in rare instances to have caused the development of adenocarcinoma (Rosser), and most rectal surgeons have seen isolated examples of this. It is a very moot point whether internal haemorrhoids should be regarded as in any way causal of carcinoma, and probably there is no direct relationship. Fig. 43 illustrates a carcinoma which appeared to have arisen in a traction ulcer from a fibrous polypus and thus may be considered to be distantly related to a haemorrhoid.

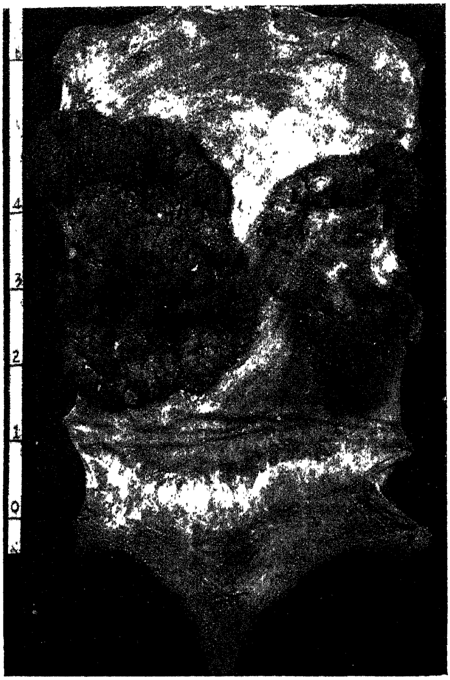

FIG. 51.—Villous tumour of lower third of rectum, with malignant change in right-hand portion, removed by perineal excision. (From *The Postgraduate Medical Journal*, 1936)

Multiple malignant tumours

Multiple malignant tumours in the rectum are fairly common and many cases have been described (Lockhart-Mummery and Dukes; Norbury). In any series of radical operations for rectal carcinoma simultaneous double cancers will probably be found in 5 to 8 per cent; this constitutes a sound argument for doing a radical operation which will remove a long length of the rectum and pelvic colon (see Fig. 52). Not only may double rectal carcinomas occur simultaneously but they may arise at intervals. Thus in several cases a patient subjected to perineal excision of the rectum has ultimately developed another carcinoma in the pelvic colon between the colostomy and the pelvic floor.

Morbid anatomy

In its earliest stages a carcinoma of the rectum is a raised indurated nodule or a flat or slightly concave plaque raised above the level of the surrounding mucosa. As the tumour grows, its margins become more raised and everted and the central part ulcerated and deeper. A protuberant cauliflower-like type is also not uncommon. Progressive infiltration of the rectal wall takes place, and, as a general rule, the glands in the mesorectum are not involved until the malignant cells have penetrated into the peri-rectal fat.

Dukes's classification

A very important and useful classification of rectal carcinoma has been described by Cuthbert Dukes (1932) and is applicable to operation specimens in which the depth of spread can be ascertained by subsequent dissection of the specimen and microscopical examination of the lymphatic glands. Dukes described the three following groups: (i) A cases, in which the carcinoma is limited to the wall of the rectum, there being no extension into the extrarectal tissues and no metastases in the lymph nodes; (ii) B cases, in which the carcinoma has spread by direct continuity to the extrarectal tissues but has not yet invaded the regional lymph nodes; and (iii) C cases, with metastases in the regional lymph nodes (see Fig. 53).

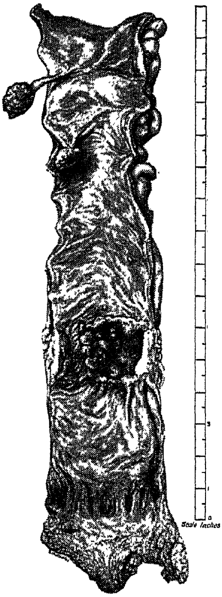

FIG. 52. — Carcinoma of rectum associated with two pedunculated tumours in lower pelvic colon; the upper of these has undergone malignant degeneration; the lower is an adenoma. Specimen removed by perineo-abdominal excision

In a large series of cases Dukes (1938) found the following grouping:

TABLE I.—Grouping of 778 Operation Specimens of Rectal Cancer Examined in the Pathological Department of St. Mark's Hospital, London, over a Period of Ten Years (1928–37 inclusive)

GROUP	NUMBER OF CASES	PERCENTAGE
A	111	14
B	272	35
C	395	51

These included both hospital cases and cases from the private practices of surgeons; separation of the two classes showed a higher proportion of A cases in private patients than in patients of the hospital class (private: 21 per cent A cases; hospital: 13 per cent A cases).

TABLE II.—Grouping of 122 Private Cases and 656 Hospital Cases

	Private Cases		Hospital Cases	
Group	No. of Cases	Percentage	No. of Cases	Percentage
A	26	21	85	13
B	37	30	235	36
C	59	49	336	51

Lymphatic spread

In cases with glandular involvement the lymphatic spread usually follows an orderly course, beginning in the glands immediately adjacent to the growth and later invading in sequence the glands along the superior haemorrhoidal and inferior mesenteric vessels. If the glands prove to be involved up to the level at which the main vessels were divided, the case is classified as C 2 (see Fig. 54); but if some non-malignant glands occur at the upper end of the vascular pedicle the case may be grouped as C 1 and has a somewhat better prognosis (Gabriel, Dukes, and Bussey).

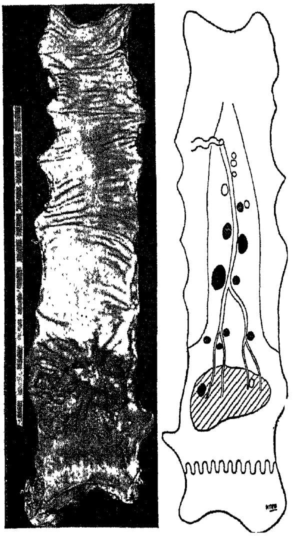

Fig. 53.—Carcinoma of rectum (C 1 case) treated by perineo-abdominal excision in one stage, with diagram showing lymphatic spread. Black dots indicate malignant lymphatic glands, and white rings non-malignant glands

Venous spread

A rectal carcinoma may invade the venous tributaries of the superior haemorrhoidal vein, and this introduces an element of considerable risk, for particles of tumour may be set free as emboli and reach the liver, there to develop into secondary deposits.

Submucous infiltration

Occasionally a diffuse malignant submucous infiltration of the rectal wall is found in relation to a carcinoma; this is certain evidence of extensive malignant invasion of the superior haemorrhoidal veins or trunk lymphatics, and the prognosis is correspondingly bad.

Grading by Broders's method

The varying microscopical appearances of an adeno-carcinoma form the basis of Broders's method of histological classification. In grade 1 there is a high proportion (100 to 75 per cent) of differentiated malignant cells; in grade 2 the proportion is reduced to 75 to 50 per cent; and grades 3 and 4 show increased irregularity of structure with a large proportion of undifferentiated cells and ill defined acini.

The majority of operable carcinomas of the rectum belong to grades

1 and 2, and the end-results of surgical treatment are, on the whole, good. Grades 3 and 4, however, are rapidly growing, highly malignant tumours and show a high percentage of inoperability, and those which appear suitable for surgical eradication are almost invariably found to have glandular metastases at the time of operation.

Clinical picture

Local characters

The chief local characters of a malignant tumour of the rectum are induration which is appreciated digitally and the presence of a palpable mass or ulcer in the rectal wall. In its early stages a carcinoma is felt as a flat sessile raised lesion, or it may be a nodular protuberant mass which is friable and bleeds on examination. With increased age a carcinoma becomes ulcerated in its centre and presents the raised indurated everted margin which, to the trained finger, is so characteristic.

Beginning at first on one aspect of the rectal circumference, a carcinoma extends circularly as well as at its upper and lower margins. The tumour eventually involves the entire circumference of the bowel, and obstructive symptoms are likely to develop; this tendency will be earlier and more prominent in the recto-sigmoid region than in the ampulla of the rectum with its much larger lumen.

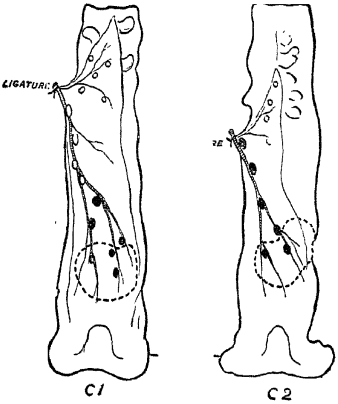

FIG. 54.—Diagrams showing subdivision of C cases of rectal carcinoma into C 1 and C 2. Black dots indicate malignant lymphatic glands, and white rings non-malignant glands. (From *British Journal of Surgery*, 1935)

Sigmoidoscopic appearance

The appearance of a rectal carcinoma as seen through a proctoscope and sigmoidoscope varies a great deal according to the stage of the disease; a sessile hyperaemic raised lesion is generally seen, with a definite edge and ulceration in the centre. In carcinoma of the rectal ampulla proctoscopy and sigmoidoscopy give ready confirmation, the only difficulty being if the rectum is full of faeces or discharge; sometimes a tumour is extremely friable, so that it is difficult to obtain a clear view, and the examination should be repeated on a subsequent occasion. Sigmoidoscopy is essential for the diagnosis of a recto-sigmoid carcinoma, which may just be palpable as an indistinct mass or may be completely beyond reach of the finger. Here again difficulty may be caused by bleeding, discharge, and fluid faeces trickling down, by spasm of the bowel, or by an acute turn of the bowel to the left; perseverance and re-examination are needful.

Digital examination

Digital examination of a rectal carcinoma gives all-important information about its extent, the depth of ulceration, and its mobility. In women vaginal examination may reveal in an advanced case involvement of the posterior vaginal wall or the posterior fornix.

Bleeding

Discharge

Bowel irritability

Increasing constipation

The symptoms produced by a carcinoma of the rectum in its early stages may be very slight. A little bleeding at stool is often the earliest symptom. A discharge of mucus is common, especially in protuberant cancers and those which arise in pre-existing adenomas or villous tumours. Next there may be slight morning irritability of the rectum, with possibly a feeling of incomplete defaecation and inability to empty the rectum satisfactorily at one sitting. Increasing constipation is next noted, with a failure of the usual bowel regularity and the need for the first time to take aperients, or the necessity to increase the habitual dose of a laxative.

Late symptoms

Pain

Among the late symptoms are alternating constipation and diarrhoea, deep sacral or pelvic pain, and a feeling of pressure in the rectum with frequent calls to stool. Severe anal pain is caused by the downward extension of a rectal carcinoma to the anus, with involvement of the anal sphincters. A large mass fungating out onto the buttocks is seen in some late cases. The development of a peri-rectal or ischiorectal abscess will account for a throbbing pain of a different character. Recto-vaginal or recto-urethral fistulae occur in late cases only.

Cachexia and late abdominal signs

Sleeplessness, loss of appetite, and wasting usher in the late stages of the disease, and finally abdominal symptoms may become prominent; abdominal pain and distension are evidence of intestinal obstruction or ascites; enlargement of the liver and jaundice indicate metastases in the liver. Enlargement of the glands in the left side of the neck through the thoracic duct and distant metastases to the lungs, brain, or bones are rare.

Course and prognosis

Direct and lymphatic spread

Cancer of the rectum extends as a rule by a slow and steady direct spread through the rectal wall and then, after reaching the mesorectal glands, along the main path of upward lymphatic spread with the superior haemorrhoidal vessels. The spread is slow, particularly in the grade 1 and 2 carcinomas; this includes carcinomas arising in pre-existing villous tumours, in which the malignant tumour is usually superficial and well differentiated.

The slow progress of a rectal carcinoma is well exemplified by the case of a woman, aged 62, who had a movable protuberant carcinoma in the rectal ampulla, proved by biopsy to be a grade 1 carcinoma and probably of the A group; she refused radical operation or any other treatment until 23 months later, when she consented to operation, although by this time she had lost much weight and had become extremely anaemic. Laparotomy showed no sign of abdominal metastases, the rectum was found to be still within the range of a perineal excision, and a good immediate recovery ensued. Examination showed that gross extension into the peri-rectal fat had taken place, and metastases were present in two of the regional glands. The main tumour was still of grade 1 malignancy.

Colloid carcinoma

The prognosis of colloid carcinomas was formerly supposed to be almost hopeless. Some A and B cases, however, show colloid change, and the prognosis does not appear to be worse for them than for the non-colloid cases in these groups; Dukes (1932) expressed the opinion that 'the important prognostic feature in colloid cancer is the extent of the growth, and not the presence of colloid degeneration'.

Local characters

A superficial mobile protuberant growth is often in the A or early B group, and the prognosis after eradication is good, whereas a deeply ulcerated growth is probably a C case with a doubtful prognosis. Involvement of other viscera, particularly those on the anterior aspect of the rectum, means a bad prognosis; similarly, adhesion to the front of the sacrum, fixity in the pelvis, and palpable extra-rectal spread are all evidence of late disease with a bad prognosis. In these advanced cases not only is the risk of operation increased, but the prognosis as regards cure is enormously impaired once metastases in the lymphatic glands have developed.

Double carcinoma

The presence of a second carcinoma may not impair the prognosis if it is small and superficial; but, if it has become ulcerated and has produced glandular metastases at a higher level and separate from any caused by the lower tumour, this must seriously affect the prognosis and render the chances of cure from a radical operation more remote.

Venous involvement

Invasion of the superior haemorrhoidal vein or its tributaries by a rectal tumour, with its risk of early metastases in the liver through the portal vein, introduces an incalculable element in prognosis. Venous involvement should be carefully looked for in all operation specimens; if it is present, the prognosis as regards cure is doubtful.

General condition

The general condition of the patient is of the utmost importance. The lean fit type with a slow regular pulse and equable temperament has a far better chance of surviving a major radical procedure than has the short and stout breathless individual with a rapid pulse and nervous temperament.

Sex

The risk of operation is less in women than in men, particularly when the tumour is in the upper third of the rectum so that a combined excision is necessary; in a stout man with a recto-sigmoid carcinoma the risks of operation are considerable, and the prognosis is correspondingly grave.

Advanced age

Advanced age adds to the risk of operative treatment. Thus in a series of 500 perineal excisions at St. Mark's Hospital, in 37 patients aged seventy or over there were 8 deaths (20 per cent), whereas in the whole series the mortality was 10 per cent. The chief operative risks in extreme old age are cardiac failure, pulmonary complications, and renal failure.

Carcinoma in young subjects

Rectal carcinoma extends rapidly in all grade 3 and 4 cases and almost invariably in young subjects. For instance, during 1937, 6 patients under the age of thirty were admitted to St. Mark's Hospital with cancer of the rectum and subjected to excision of the rectum; in every case the regional glands contained metastases, the specimen being grouped as C 2 in five cases and C 1 in one case; in two cases venous involvement was present.

Diagnosis and differential diagnosis

Clinical diagnosis

The symptoms and signs of an advanced carcinoma of the rectum are highly characteristic, and the diagnosis is not likely to be in doubt. In early cases, however, symptoms may be very slight or obscured by the presence of some minor rectal lesion, such as prolapsing piles, fissure, or fistula; in these cases careful routine examination with sigmoidoscopy is needed to avoid overlooking an early malignant tumour. Repeated examinations are often advisable and necessary.

Diagnosis of malignancy

The clinical diagnosis of malignancy is sometimes difficult if the tumour was at first a benign adenoma or papilloma. The points to be considered in such cases are: (i) the history; a marked exacerbation in the bleeding and discharge suggests ulceration and malignant change; (ii) ulceration and induration in a previously benign tumour are usually strongly in favour of carcinomatous change.

Biopsy

Fragments removed for biopsy sometimes prove the onset of malignancy, but a negative histological report must not be taken as conclusive evidence against malignancy. Portions of a malignant tumour or ulcer may be removed for biopsy with Brünings's forceps (see Vol. IV, Fig. 126, p. 597) or other biopsy forceps (see Fig. 55). A skilled pathologist is able to suggest a preliminary grading of the fragments according to Broders's classification, but such grading should be regarded as provisional and subject to later correction. It is rarely wise for a surgeon to base his plan of treatment solely on the grading of biopsy fragments.

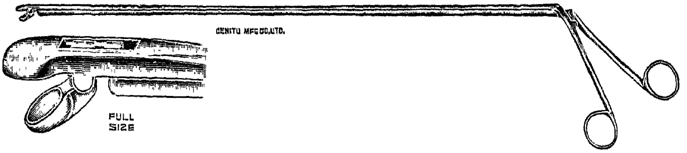

FIG. 55.—Biopsy forceps

Barium sulphate enema

A barium sulphate enema examination is sometimes of value in the diagnosis of a suspected carcinoma in the recto-sigmoid region; for instance a doubtful induration may be felt high up on rectal examination but a sigmoidoscope fail to reach the lower border of a malignant ulcer, possibly because of spasm or a sharp turn of the bowel immediately below the tumour. In such cases a barium sulphate enema may reveal an organic lesion as (i) a filling defect, (ii) a stricture which permits a little barium sulphate to pass up into the pelvic and iliac colon (see Plate IX, B), or (iii) a complete obstruction; the rectum becomes ballooned out by the barium sulphate, but none passes up into the colon. The last is the commonest positive result in this type of case, but the examination is open to several fallacies: an appearance of obstruction may be due to spasm, incomplete preparation of the bowel, or failure to distend the rectum properly with the opaque enema;

on the other hand, the enema may appear to pass up quite normally and an organic stricture be missed. The X-ray examination in such cases should include screening and preparation of films in the lateral and oblique planes as well as in the antero-posterior; if a barium sulphate enema is negative so far as the recto-sigmoid is concerned, this part of the large bowel should not be passed as normal until a sigmoidoscope has given a clear view up to 8 to 10 inches from the anus.

Differential diagnosis

The differential diagnosis must be made from the following conditions. (i) Benign epithelial tumours, such as adenoma and papilloma, or benign connective-tissue tumours, such as lymphoma and myoma. (ii) Malignant tumours arising outside the rectum and invading it from without; of these, carcinoma of the prostate and cervix are not unusual, and occasionally a carcinoma of the pelvic colon becomes adherent at the bottom of the pelvis and invades the supra-peritoneal portion of the rectum. (iii) Secondary malignant tumours due to peritoneal implantation in the recto-uterine excavation (pouch of Douglas), e.g. from carcinoma of the stomach or ovary. (iv) Endometrioma of the recto-sigmoid or recto-vaginal septum. (v) Inflammatory stricture of the rectum, including strictures due to lymphopathia venereum and those temporary strictures with submucosal swelling following injection of phenol in oil for treatment of haemorrhoids or prolapse. A grade 4 carcinoma of the extremely undifferentiated type closely simulates an inflammatory stricture. (vi) Sarcoma of the rectal wall, an extremely rare tumour with much submucous infiltration; slight ulceration of the mucosa, either localized or diffuse, may be present. (vii) Radium burn of the rectal wall produces an appearance which may be mistaken for a carcinoma: an ulcer may be seen, usually on the anterior wall of the ampulla of the rectum at approximately the same level as the cervix uteri, with a marked hyperaemia of the surrounding mucosa and later much peri-rectal fibrosis. The history of previous radium treatment to the cervix should at once suggest the condition. (viii) Carcinoma in the recto-sigmoid region may be simulated by diverticulitis, especially when the intestinal lumen is narrowed and the mucosa inflamed and oedematous. In such cases laparotomy may be needed to clear up the diagnosis. (ix) In ulcerative colitis and any form of proctitis the symptoms of bleeding, discharge, and bowel irritability closely resemble those of carcinoma of the rectum.

Treatment

(i) *Preventive*

The removal of benign adenomas and papillomas of the rectum and the adequate treatment of patients with polyposis are most important in the prevention of rectal carcinoma.

(ii) *Surgical*

Surgical eradication is the treatment of choice in the vast majority of rectal carcinomas; the ideal would be to operate at an early stage before the tumour has invaded the regional lymphatic glands, but Table I shows that in a large series of cases 50 per cent of those submitted to operation fell into groups A and B, and 50 per cent had glandular metastases.

Radical operations

Radical excision of the rectum by the abdomino-perineal, perineo-abdominal, or perineal routes is the accepted method of treatment in most cases, the exact operation required being a matter of judgement by the surgeon in each particular case, according to the general condition of the patient, the site and size of the tumour, and the estimated extent of the disease. In these operations a permanent colostomy is essential.

Risk of operations: perineal excision

The operative risk of perineal excision of the rectum is now only 5 per cent or less, although it appears in Table III as 7 per cent for the total group; the relation of the mortality to the stage of the disease is evident.

TABLE III.—Operation Mortality after Perineal Excision of the Rectum (St. Mark's Hospital)

CLASSIFICATION OF TUMOUR	SUBMITTED TO OPERATION	DIED FROM OPERATION	OPERATION MORTALITY (per cent)
Group A	46	0	0·0
Group B	100	5	5·0
Group C	140	15	10·7
Total	286	20	7·0

Combined excision

The operative mortality of combined excision of the rectum is certainly higher, and this must be the case if fairly advanced cases are undertaken, especially in males. In 1931 Lawrence Abel described a series of 76 abdomino-perineal excisions with a mortality of 6 (7·9 per cent). If the operation is done without a too rigid exclusion of borderline cases or patients of advanced age, and under the best conditions of team-work and hospital organization with routine blood-transfusion, the mortality of combined excision of the rectum is likely to be about 10 or 12 per cent. Thus in my last 50 cases of perineo-abdominal excision in one stage the deaths have numbered 6 (12 per cent); the fatalities all occurred in men, their ages ranging from 61 to 75.

End-results

The end-results, in terms of 5-year cures, undoubtedly vary a great deal according to the stage of the disease; in any series the cases with glandular metastases operated upon are certain to have a relatively poor prognosis, to the detriment of the total figures. The great advantage of adopting Dukes's classification is that it enables statistics to be rendered comparable; unless cases are dissected into A, B, and C groups, it is impossible to compare end-results.

TABLE IV.—Results of Perineal Excision on a Five-Year Basis (St. Mark's Hospital)

CLASSIFICATION OF TUMOUR	OPERATION SURVIVALS	UNTRACED AND DIED OF OTHER CAUSES	ALIVE AT 5 YEARS	PERCENTAGE OF 5-YEAR SURVIVALS
Group A – –	30	2	26	93
Group B – –	50	7	28	65
Group C – –	62	5	13	23
Total –	142	14	67	52

Perineo-abdominal excision

Table V is based on a small series of perineo-abdominal excisions which have now passed the 5-year period; the result to date in C cases suggests that a combined excision is likely to give a somewhat better percentage of cures than a perineal excision.

TABLE V.—Results of Perineo-Abdominal Excision on a Five-Year Basis (St. Mark's Hospital)

CLASSIFICATION OF TUMOUR	OPERATION SURVIVALS	UNTRACED AND DIED OF OTHER CAUSES	ALIVE AT 5 YEARS	PERCENTAGE OF 5-YEAR SURVIVALS
Group A – –	4	0	4	100
Group B – –	10	0	9	90
Group C – –	11	0	4	36
Total –	25	0	17	68

Out of 14 A and B cases 13 reached the 5-year period, but out of 11 C cases only 4 survived. The figure of 68 per cent of 5-year survivals for the total is almost identical with that of 69·3 per cent reported by Abel for a series of 150 abdomino-perineal excisions traced over a period of 5 years.

Conservative resection

Occasionally it may be justifiable, in certain early and carefully selected cases, to preserve the anal sphincters by performing a conservative type of resection (abdomino-anal or sacral); a preliminary transverse colostomy to 'defunction' the distal colon is a valuable adjunct to these operations (Devine).

Local resection

Local resection is only permissible in the case of a polyp with terminal malignant change, the pedicle being soft and clinically free from invasion.

Colostomy

Palliative colostomy is required for inoperable rectal cancers, the chief indication being intestinal obstruction. Profuse bleeding and discharge, severe anal pain from involvement of the sphincters, or the formation of recto-vaginal or recto-vesical fistulae are other indications, in all of which a colostomy with a good spur will give varying relief. In most of these cases the iliac colon should be utilized if possible; a transverse colostomy should be made only if the iliac colon cannot be mobilized sufficiently. Colostomy should be avoided if the patient is not seen until the disease is so late that jaundice from hepatic metastases or ascites from peritoneal dissemination is present.

(iii) *Diathermy*

Diathermy electro-coagulation (desiccation) may be used in some cases, particularly the large fungating tumours in the ampulla of the rectum which are inoperable or ineradicable on account of the patient's age or general infirmity. In such cases desiccation may be combined with colostomy, or it may be tried without colostomy. In favourable cases discharge and tenesmus will be reduced, and comfortable life may be considerably prolonged, as reported by Strauss and his associates and by Johnson.

A very small flat superficial and mobile carcinoma with a maximal diameter of 2 cm. may sometimes be justifiably treated by electro-coagulation; but if there is any clinical evidence of adherence to the muscular coat of the rectum a radical operation should be urged (Fansler).

(iv) *Radiotherapy*

Radium

Columnar-celled carcinoma of the rectum is radio-resistant; radium and X-rays are therefore now seldom used except for inoperable cases. The interstitial method of radium needling has been discontinued, but the intra-rectal insertion of radium is safe and has been developed by Stebbing on the following lines: after a preliminary colostomy a full course of deep X-ray therapy is given, and then, after two weeks' interval, intra-rectal radium is inserted by Stebbing's applicator; 30 to 50 mgm. of radium are used, the exposure being 70 to 120 hours, which gives a dose of about 6,000 r to the surface of the tumour (Morgan). Alternative methods of radium treatment are radium bomb therapy and the insertion of radon seeds by means of a special introducer through a sigmoidoscope or long proctoscope.

X-rays

X-ray therapy, both high and low voltage, is used, but no standard technique is yet recognized, and the variable results indicate the difficulty of irradiation methods in rectal cancer. Levitt stated that superficial metastases from carcinoma of the rectum often yielded to X-ray treatment.

(v) *Symptomatic*

Symptomatic treatment is required in all inoperable cases of rectal cancer and in those which present evidence of recurrence after excision of the rectum. Relief of pain is the chief indication; at first aspirin, compound aspirin, or veganin will suffice, but in the late stages nepenthe or omnopon orally will be required, or morphine, omnopon, or heroin hypodermically.

Relief of pain

Pre-sacral neurectomy

If severe pain appears to be due to involvement of other pelvic organs, a pre-sacral neurectomy may be considered; this is with advantage combined with a colostomy if not previously established.

Pain due to involvement of the sphincters is often greatly relieved by intrathecal injection of absolute alcohol by the method described by Dogliotti. Papers dealing with this method have been published by Yeomans and by Constance Ottley. The dose of absolute alcohol is 0·5 to 0·8 c.c., which is injected through a fine spinal needle with the patient lying on his side in a slight Trendelenburg position or in Hanes's position. Some anaesthesia develops in the lower sacral and anal region, and, if necessary, the injection can be repeated after an interval of some weeks; a colostomy should be done before the injection. *Intrathecal injection of alcohol*

Rectal discharge is sometimes relieved by irrigation of the rectum with saline, hamamelis, or sanitas solutions, and, if a colostomy has been established, the rectum may be washed out through the lower colostomy opening. Suppositories of morphine and belladonna are occasionally helpful in promoting sleep and minimizing rectal discharge. *Rectal irrigation*

11.–SARCOMA AND MELANOMA

Sarcoma

1356.] A sarcoma of the rectum is a round- or mixed-celled tumour which originates in the connective tissue of the rectal wall. It usually produces a diffuse malignant infiltration of the rectal wall, with narrowing of the lumen and perhaps superficial ulceration. In another type a small localized ulcer in the mucosa of the lower rectum is produced, and in all cases a massive extra-rectal lymphatic spread occurs very early. *Clinical types*

The symptoms are chiefly bleeding and discharge, with a rapid decline of weight and strength. In the late stages the symptoms resemble those of an adeno-carcinoma. The diagnosis of sarcoma may be suggested by the above findings together with palpable evidence through the rectal wall of unusual extra-rectal lymphatic spread. Biopsy may occasionally clinch the pre-operative diagnosis. *Symptoms* *Diagnosis*

Treatment is not likely to be satisfactory in these cases; X-ray or radium-bomb therapy is the most suitable line of treatment if the diagnosis is made before any radical operation is attempted. If the rectum is excised, extensive lymphatic spread beyond the operative field is probable, and X-ray therapy should be started as soon as the patient is considered to be sufficiently fit. Early recurrence must be expected. *Treatment*

Melanoma

A malignant melanoma (melanotic sarcoma or melano-carcinoma) occurs rarely at the upper end of the anal canal. It is usually semi-pedunculated with rather a broad base; its nature is not usually ascertained until after removal. Recurrence after a local excision is likely to be rapid, but a radical excision offers some hope of a better result. A very complete case has been recorded by Lindner and Quarry Wood. This tumour, in a woman aged fifty-three, was an indurated sessile mass on the posterior wall at the ano-rectal junction; it resembled an adeno-carcinoma and was treated by colostomy and perineal excision; seven months later the patient was in good health with no sign of recurrence.

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REFLEXES IN DIAGNOSIS

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Reference may also be made to the following titles:

ABDOMINAL PAIN
ARGYLL ROBERTSON PUPIL
BRAIN: REGIONAL DIAGNOSIS
BRAIN TUMOUR
BRAIN: VASCULAR DISORDERS
CEREBELLAR DISEASES
CEREBRAL DIPLEGIA
COMA
DISSEMINATED SCLEROSIS
MOTOR NEURONE DISEASE
NERVE INJURY AND REPAIR
SPINAL CORD DISEASES

1.–INTRODUCTION

1357.] A complete clinical examination of the nervous system includes as an important integral part the study of certain reflex reactions: the tendon-jerks, the cutaneous reflexes (including the plantar response), and the pupillary reactions. These may deviate from the normal not only in structural disease of the nervous system but also in some general diseases and in certain forms of poisoning.

This article deals only with the tendon-jerks, the cutaneous reflexes, and the abnormal form of plantar response named after Babinski, who first described it. Visceral reflex reactions and the pupillary reactions have been dealt with elsewhere. Observations and records have been made of very many tendon and cutaneous reflexes other than those here described, many of which are not essential to the ordinary requirements of diagnosis. For details about these the reader is referred to special text-books of neurology. This article deals only with the reflexes of known significance and of practical usefulness in routine examination.

2.–PHYSIOLOGY

These reflex reactions include the following anatomical and physiological components: (i) the receptive field, (ii) the stimulus, and (iii) the muscular response.

Receptive field

(i) Each reflex has its own peculiar receptive field or reflexogenous zone, which may be purely cutaneous, may lie wholly in the deep (muscular) structures, or may include both areas.

Stimulus

(ii) For each category of reflex there is a specific variety of stimulus, the 'adequate stimulus'. This may be simple contact, as in the corneal reflex; a stroking contact, as in the abdominal reflex; or a firmer stroking movement involving deep pressure or painful cutaneous stimulation, as in the Babinski type of plantar response.

Muscular response

(iii) The muscular response is a co-ordinated one, involving a movement of brief duration (phasic reflex) or persisting as a new posture of the part involved (tonic reflex). The contraction is of harmoniously acting muscles, the antagonists of which are correspondingly inhibited (reciprocal innervation).

These points will now be discussed in greater detail in respect of the main types of reflex reaction under consideration.

(1)—Tendon-Jerks

Stretch reflex

When a muscle is stretched passively by gravity, by manipulation, or by the contraction of an antagonist, its fibres actively resist the stretching force and enter into increased and maintained tension. This resistance is a reflex process, the receptors concerned being the 'stretch receptors', which lie in the fleshy part of the muscle. Thus there is what may be called a 'stretch reflex'. To quick short-lived stretch the muscle responds by a quick and equally short-lived increase of tension and shortening. The tendon-jerk is such a proprioceptive stretch reflex. If the muscle concerned is already in increased tonus (spasticity), the response is brisker and tends to last longer, to relax incompletely, and sometimes to pass into clonus. There are two components in the stretch reflex: a phasic and a tonic. In the tendon-jerk the phasic predominates.

Reflex arc

The reflex arc involved passes from the muscle along the mixed nerve, which carries both afferent and efferent fibres, to the corresponding segment of the spinal cord, where the reflex centre lies. The tendon-jerk may therefore be abolished by any interruption of the afferent or of the efferent limb of the arc or by a lesion of the grey matter of the reflex centre in the cord. If the reflex arc is intact, the reflex may yet be modified by influences reaching the centre from above.

(2)—Cutaneous Reflexes

These are elicited by a stroking contact, generally involving some stimulation of subcutaneous receptors also, and consist in a brief quick contraction of a muscle or muscles in the same segmental territory as the skin area stimulated. Thus stimulation of the upper abdominal quadrant leads to contraction of the muscles of the abdominal wall of this quadrant. These simple reactions are normally present in the healthy abdominal wall but commonly disappear upon interruption or suspended function of the upper motor neurone.

Normal plantar response

The normal plantar response, which is elicited by stroking the sole of the foot, belongs to this group. Not only does it disappear in the circumstances just described, but its place is taken by a completely different reflex reaction, which is not purely cutaneous and is known as the extensor or Babinski plantar response.

(3)—Babinski Plantar Response

The element of this complex reaction of significance to the clinician is the up-going or dorsi-flexor movement of the great toe when the sole of the foot is stroked. Its extreme practical importance consists in the fact that it is a reliable and virtually constant index of interruption of the pyramidal tract. This interruption may be structural or physiological and transient only. There is probably no single abnormal physical sign obtainable on examination of the nervous system more important than this phenomenon first described by Babinski and bearing his name, and its physiological interest is equally great.

Significance

Receptive field

When this response is fully developed, the receptive field may include the skin and deep structures of the limb up to the lower third of the thigh. Within this region scratching, pricking, pinching, or deep stroking will suffice to elicit it. The threshold of stimulation is lowest over the outer half of the sole, where the response is most easily obtained. Within this wide field of skin, subcutaneous tissues, muscle, and bone several observers—before the full meaning of the reflex was realized by practitioners—found that particular regions of the limb gave on stimulation a Babinski response. Thus Oppenheim found that on deep downward stroking of the shin he could elicit the response, Gordon from pinching the skin over the calf, and Chaddock by deep stroking below the external malleolus. The names of the discoverers have been attached to these different manœuvres for obtaining a single response and sometimes unnecessarily complicate clinical case reports. Only a single reaction is concerned, elicited from different parts of a wide receptive field, and the description of these manœuvres as separate reflexes has nothing to commend it.

Stimulus

The stimulus commonly used has already been described. Simple tactile stimulation, e.g. touch and cotton-wool stroking, is generally insufficient, and a potentially harmful stimulus, e.g. a prick, a scratch, and a firm stroke with a pointed object, i.e., in physiological terminology, a nociceptive stimulus, is the most efficient.

Muscular response

The muscular response is never limited to dorsi-flexion of the hallux, though in some instances this may be all that is easily noticeable. All the flexor and dorsi-flexor muscles of the limb respond by contraction and their antagonists by reciprocal inhibition. Thus there may be dorsi-flexion and separation of the toes, dorsi-flexion of the foot, and flexion of the limb at knee and hip. In even the minimal response a finger placed over the hamstring tendons behind the inner aspect of the knee reveals a palpable contraction of these muscles. In a maximal response the whole limb may go into quick powerful flexion. The response is therefore in essence a withdrawal or flexion response.

Crossed plantar response

When both limbs are affected, i.e. in spastic paraplegia, this response to stimulation of the sole may be accompanied by the crossed plantar response: a downward (plantar-flexor) movement of the great toe and sometimes of the foot of the crossed limb.

Response in severe paraplegia-in-flexion

In severe paraplegia of the type known as paraplegia-in-flexion, stimulation of the sole not only elicits the Babinski response of the toe but may also evoke a powerful and complete flexion of the entire limb, which may remain in the flexed position. In these circumstances the reaction is commonly obtainable from the distal three-quarters of the lower limb by pinching or pricking the skin. On the other hand, in hemiplegia the receptive field may be limited to the outer half of the sole of the foot, where invariably the threshold is lowest.

In hemiplegia

In total flaccid paraplegia

The most reduced form is that found in the total flaccid paraplegia that follows transection or crushing of the spinal cord. Here only a feeble palpable contraction of the hamstrings may be elicited by stimulation of the sole immediately after the lesion has occurred, but within a few days dorsi-flexion of the hallux is added, and, if the patient survives, a complete flexion reaction may develop with an extensive receptive field.

These two reflexes, the Babinski and the crossed plantar responses, correspond to the nociceptive flexion and crossed extension reflexes respectively of the spinal and decerebrate animal (Sherrington). It has been said that the plantar response of the healthy new-born infant is the Babinski response, and that this persists during the first year of life; but its appearance may be very short-lived, and a normal response may be present within the first few months.

3.–CLINICAL ASPECT

(1)—Tendon-Jerks

Increase

The tendon-jerks are subject to increase in organic disease or in injury interrupting or impairing the functions of the pyramidal system. In these circumstances this increase may be accompanied by patellar or ankle clonus and may be said to be constantly accompanied by the Babinski plantar response. They may also be increased in diseases of the extrapyramidal nervous system, e.g. paralysis agitans, but in this case clonus is absent and the plantar response normal. Also in certain neuroses, under emotional stress, and in states of debility they may be increased, the cutaneous and plantar reflexes remaining normal.

Diminution or abolition They are diminished or abolished in lesions involving the reflex arc, i.e. the afferent or efferent neurone, or the motor nerve-cell in the ventral horn of the cord. Thus they disappear early in tabes dorsalis, polyneuritis, and acute poliomyelitis. In muscular diseases the tendon-jerks subserved by the wasted muscles disappear sooner or later.

They disappear transiently during the stage of flaccid coma that ensues upon the convulsion in a major epileptic fit, and sometimes when the intracranial tension is raised in the presence of tumour of the brain they may be absent. Finally, the tendon-jerks vary somewhat from one normal subject to another in the ease with which they can be elicited and in their briskness. In old age it is not uncommon to find the ankle-jerks diminished or absent, and in earliest infancy it may be difficult or impossible to obtain them. They may disappear in pneumonia and occasionally in enteric fever.

Segmental localization The segmental localization of the tendon-jerks is as follows: jaw-jerk, trigeminal nerve; biceps-jerk, fifth and sixth cervical; triceps-jerk, sixth and seventh cervical; supinator-jerk (radial reflex), seventh and eighth cervical; knee-jerk (patellar tendon), second to fourth lumbar; and ankle-jerk (tendo calcaneus or Achillis), fifth lumbar to second sacral.

Inversion of radial reflex Babinski pointed out that in certain circumstances the radial reflex, elicited by tapping the lower end of the radius and consisting of a contraction of the brachioradialis (supinator longus) muscle, might be replaced by a contraction of the finger flexors, i.e. by a brief flexion of the two terminal segments of the four fingers. Sometimes the radial response may be present or diminished but accompanied by a brisker response of the fingers. This he called 'inversion of the radial reflex', and he has found that this inversion is associated with a local lesion involving the fifth and sixth cervical segments of the spinal cord. Such a lesion occurs most often in syringomyelia and in traumatic lesions of the fifth cervical segment in association with fracture or dislocation of the cervical spine between the fifth and sixth vertebrae. Therefore inversion may be a valuable diagnostic sign of such injuries and should be sought for in suspected cases.

(2)—Cutaneous Reflexes

In general these are abolished by lesions of the pyramidal system, but their disappearance is subject to exceptions not yet fully understood. Those of clinical importance are as follows, together with their segmental localization: abdominal reflexes, (i) upper, eighth and ninth thoracic; (ii) lower, tenth to twelfth thoracic; cremasteric reflex, first and second lumbar; normal plantar reflex, first and second sacral; bulbocavernosus reflex, third sacral; and anal reflex, fifth sacral. The Babinski type of plantar response does not belong to this category (see p. 560); it is not purely cutaneous, and it represents the 'flexion reflex' of the physiologist.

Abdominal reflexes

The abdominal reflexes are usually abolished on the affected side in hemiplegia, below the level of a local lesion of the spinal cord, and in systemic degenerations of the pyramidal system. This generalization is subject to the following qualifications: (i) the reflexes may return ultimately after some time in cases of hemiplegia, especially in infantile hemiplegia; (ii) they disappear early in the course of disseminated sclerosis, but relatively later in systemic degenerations of the pyramidal tract; and (iii) they may return in cases of spinal cord transection if the patient survives sufficiently long for the condition of 'spinal shock' to pass off.

They are intact in diseases involving only the extrapyramidal motor system, e.g. paralysis agitans and post-encephalitic Parkinsonism, and in systemic lesions confined to the afferent nervous system, e.g. tabes dorsalis.

Cremasteric reflex

The cremasteric reflex follows the rules observed by the abdominal reflexes.

Bulbocavernosus and anal reflexe

The bulbocavernosus and anal reflexes have not been so exhaustively studied as those already considered, but their disappearance is rare. Even immediately after spinal cord transection they may be active, though they disappear when local disease of the sacral segments of the cord destroys the grey matter of these segments. The anus then becomes patulous. Therefore the disappearance of these reflexes may be taken to indicate local disease in these segments.

(3)—Babinski and Crossed Plantar Responses

Causation o Babinski response

The essential condition of the appearance of these two abnormal responses is interruption or suspension of function of the pyramidal (upper motor) neurone. In this way the spinal centres are released from higher control, and reflex reactions which are normally absent make their appearance. For practical purposes the Babinski response may be regarded as the earliest and most constant sign of this release, and therein lies the great importance of this physical sign. The full range of the response to stimulation of the sole (preferably its lateral half) has been described on page 561. The practitioner relies upon the dorsi-flexor movement of the great toe, but this is often accompanied by dorsiflexion and fanning of the other toes, by some dorsi-flexion of the foot, and by a quick flexion of the limb at hip and knee of slight amplitude. The up-going movement of the hallux may be deliberate, or it may be rapid and brief—the latter usually when the limb is definitely spastic in extension.

Crossed plantar response

The crossed plantar response is rarely seen except in an appreciably spastic limb. In hemiplegia stimulation of the sole of the normal side may evoke this response, i.e. plantar-flexion of the hallux, in the foot of the affected side, whereas in spastic paraplegia it may be elicited on either side on stimulation of the opposite sole.

Clinical significance of Babinski response

Disease involving the pyramidal system at any part of its course from cerebral cortex to the lower levels of the cord leads to the development of the Babinski response, but this response may also appear when the functions of the pyramidal neurone are interfered with in the absence of structural lesion. Thus it may be present in certain aetiological varieties of coma, though not in all. It is found in the stage of flaccid coma that ensues upon the convulsion of a major epileptic fit, and in the coma of certain intoxications: coal-gas poisoning, barbiturate poisoning, morphine and opium poisoning, delayed chloroform poisoning, and acute yellow atrophy of the liver. It has been stated that it appears in hypoglycaemic, though not in diabetic, coma. Indeed, the range of toxic states in which this abnormal reflex may be found has not yet been fully worked out. But it follows from what has been said that the presence of a bilateral Babinski plantar response in a comatose person does not necessarily indicate the presence of structural nervous disease. On the other hand, the unilateral presence of this response can only be correlated with a local lesion of the brain.

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REFRACTION, PRACTICAL METHODS

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Reference may also be made to the following titles:

ASTIGMATISM
EYE EXAMINATION
HYPERMETROPIA
MYOPIA
PRESBYOPIA
STRABISMUS

1.–INTRODUCTION

Preliminary examination of eye

1358.] Time is saved and much perplexity avoided in the practice of refraction if the eyes are thoroughly examined beforehand. Otherwise effort may be wasted in struggling to obtain full normal vision by trial lenses in a patient with macular degeneration or some other abnormality of the fundus or of the media. If, however, a careful survey has been made of both eyes, it is possible in most cases to know what degree of vision can be expected both with and without glasses. With increasing experience the observer can discover by a few minutes' scrutiny most of the usual obstacles to vision. If there should still be an unexpectedly poor response to trial lenses, he can re-examine the patient more exhaustively, using a mydriatic if necessary.

Dilatation of pupils

The next step depends on whether the refractionist is experienced or not. Until he has tested at least a few hundred cases, he should dilate the pupils in every case, unless there is some definite contra-indication, e.g. threatened or present glaucoma. At a busy hospital clinic, when many patients must be tested in a comparatively short time, it is simpler and more accurate to use drops however experienced the refractionist may be.

2.–REFRACTION WITH MYDRIATIC

Technique

Mydriatic

First, the distance vision should be recorded in each eye separately with the test-types (see p. 570). If glasses have been recently worn for distance, the difference, if any, between unaided vision and vision with the patient's glasses should be noted. To dilate the pupils in an adult, a drop of an aqueous solution of homatropine hydrobromide and cocaine hydrochloride, 2 per cent of each, is instilled into both eyes. The patient should be seated and looking upwards, while the refractionist draws the lower lid downwards and places a drop on the inner surface of that lid, at the same time holding a small piece of gauze on the cheek immediately below the eyelid, in order to prevent excess fluid from running down the face. At least half an hour must be allowed for the drops to take effect, but it is more satisfactory to wait for three-quarters of an hour.

Oily solution

Many people prefer to use an oily solution, especially in younger patients, on the ground that a more complete cycloplegia is thereby obtained. This supposed advantage is more than counterbalanced, both in subjective and objective tests, by the obscuration of the cornea with a film of oil.

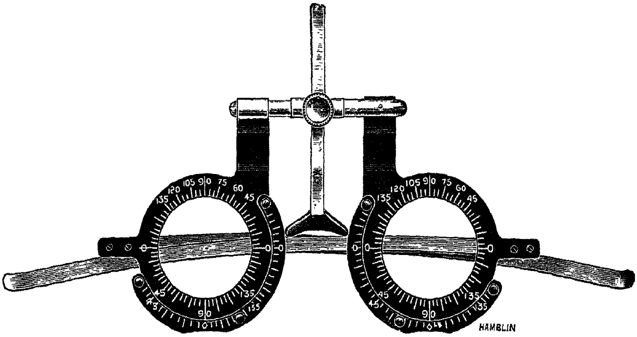


FIG. 56.—Trial-frame

Mydriasis in young children

In children under the age of fourteen accommodation is so active that homatropine and cocaine drops are inadequate for the production of complete paralysis of the ciliary muscle. For them atropine ointment 1 per cent is prescribed, to be used twice a day in each eye for four days before the dark-room examination. When a squint is present, it is advisable to emphasize that the ointment is for use in both eyes; otherwise parents may assume that only the squinting eye needs attention.

Retinoscopy

When the mydriatic has had time to exert its effect, the patient, wearing a trial-frame (see Fig. 56), should be seated in a dark-room for retinoscopy. To perform this test the observer gazes from a distance of one metre at each pupil in turn through the sight-hole of a plane mirror, by means of which light is reflected into the patient's eye from a lamp placed slightly above and behind the patient's head. The best source of light is a frosted bulb painted black, except for a round hole one inch in diameter (see Fig. 57). It is assumed that the refractionist is emmetropic or at least has his own refractive error neutralized by glasses. If the observed eye also is emmetropic, a shadow is visible, which is rendered more obvious by tilting the mirror, when the shadow moves in the same direction as the mirror. When this manœuvre is repeated after a convex lens of 1·0 dioptre in strength has been placed on the trial-frame in front of the eye, no shadow is appreciable, even when the mirror is tilted again. If a convex lens of double the above strength is substituted, the shadow reappears but moves in the opposite direction when the mirror is tilted.

Emmetropia

Movements of shadow

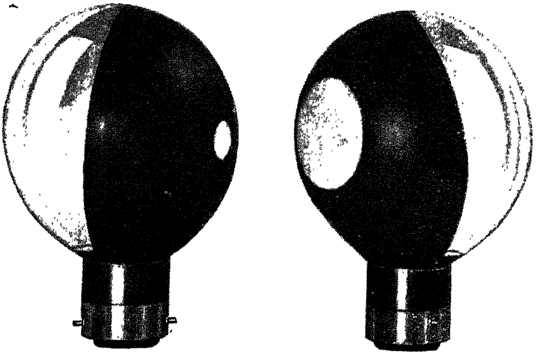


FIG. 57.—Lister ophthalmic lamp

If a myopic eye is examined by the same method, the shadow moves in the opposite direction to the tilt of the plane mirror and can be neutralized, *mutatis mutandis*, in the same way. Thus the shadow disappears when a concave glass, of a strength corresponding to the degree of myopia, is inserted in the trial-frame. When that strength is exceeded, the shadow reappears, moving in the same direction as the tilt of the mirror. The greater the amount of myopia, the slower the excursion of the uncorrected shadow when the mirror is tilted.

Myopia

Similarly a hypermetropic eye shows a shadow moving more and more slowly in the direction of the mirror, according to the extent of the refractive error.

Hypermetropia

An eye that lacks a shadow when thus examined has a low degree of myopia, i.e. about 1·0 dioptre.

Low myopia

In astigmatism the shadows move at different speeds or even in opposite directions, when the mirror is tilted along various meridians. As a rule it is possible to identify two meridians, at right-angles to each other, in which the discrepancy of the shadows is greatest. These two meridians need not necessarily be in the primary positions of 90° and 180°. All possible combinations of obliquity occur. When one main

Astigmatism

meridian is emmetropic and myopia is present in the meridian at right-angles to it, the condition is called myopic astigmatism. If myopia exists in both meridians, but to a different extent in each, it is called compound myopic astigmatism. The same principle of nomenclature applies in hypermetropic cases. Lastly, if the shadow in one meridian is in the opposite direction to that of the other, the case is one of mixed astigmatism.

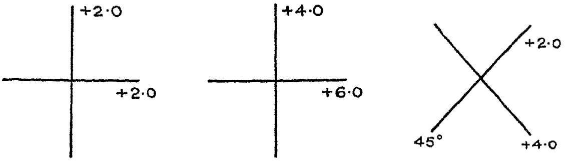
Myopic astigmatism

Compound myopic astigmatism

Mixed astigmatism

Expression of results

The results of retinoscopy are expressed in numerical form. A few examples will suffice to show how simply this can be done. It may be assumed for the moment that the retinoscopy of an emmetropic patient is expressed as in Fig. 58, *a*, which indicates that the shadow in the observed pupil moves in the same direction as the tilted plane mirror, and that the direction of the shadow is reversed in each meridian by means of a convex lens, i.e. a lens of plus sign, 2·0 dioptres in strength. Such an eye would be expected to obtain full normal vision, in the absence of ocular disease, with the aid of a +1·0 sphere, if atropine is the mydriatic used; or unaided full normal vision after recovery from the mydriatic.



(*a*) (*b*) (*c*)

FIG. 58.—Expression of results of retinoscopy

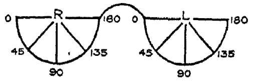


FIG. 59.—International method of notation of axes of cylinders for two eyes

If the result expressed in Fig. 58, *b* is obtained, the eye would be expected to need a +2·0 sphere while still under the influence of atropine, together with a +2·0 cylinder with its axis vertical, in order to get the best possible vision.

When the main axes are at angles different from the usual vertical and horizontal angles, an indication should be provided. Thus Fig. 58, *c* suggests that correction under atropine would be achieved by means of a +2·0 cylinder inserted at a direction of 45° down and *out*, in the case of the right eye, down and *in*, in the case of the left. Fig. 59 shows the international method of notation of the axes of cylinders for the two eyes.

It may be objected that the convention of accepting Fig. 58, *a* as the normal retinoscopy is arbitrary, and so it would be if it were accepted literally. Rather should it be understood as a convenient starting-point for description and discussion on common ground. In actual practice each observer must make his own standard. Until he has performed hundreds of refractions, he ought to check his retinoscopy by a subjective test immediately afterwards in all patients who are able to read letters. A post-mydriatic test is also advisable several days later in adults, or a fortnight later in the case of atropinized children. By this system the best possible practice can be gained in refraction work. The observer will thereby assess his own margin of error and be able to realize the limitations of retinoscopy. Finally, he will be able to order glasses direct from retinoscopy in children too young for test-types, or in illiterate older patients.

Checking of results

Retinoscopy, even in experienced hands, is not an absolutely certain guide to the glasses that will afford the best possible vision for the patient. Occasionally two or more skilled refractionists, checking each other's results, will agree that the angle and the strength of a correcting cylinder giving the best subjective result differ from those that might have been expected from retinoscopy; and in such cases it is certainly best to regard the result of the *subjective* test as decisive. In the vast majority of cases, however, no great discrepancy is apparent. It is sometimes argued that the possibility of discordant results makes retinoscopy a waste of time, and that glasses might as easily be ordered, at least in adults, by means of a purely subjective test. This attitude is certainly wrong. The hit-and-miss method must involve wasted time and wrongly prescribed glasses. In oblique mixed astigmatism, for example, retinoscopy offers most valuable guidance. Admittedly it may not of itself decide the exact strength of glass and cylindrical angle, but for practical purposes this is no great disadvantage. The retinoscopy suggests the approximate correction needed, and the subjective test can then be used as a fine adjustment; whereas in an exclusively subjective test much time will probably be expended before the right combination of lenses is found.

Value of retinoscopy

Besides those cases in which retinoscopy does not accurately tally with the subjective test, it is not very uncommon to come across eyes in which the turning-point of the shadow is somewhat indefinite. This is no great disadvantage, provided that the observer regards retinoscopy merely as an approximate guide, not an infallible index.

Causes of difficulty

Difficulty may also arise in cases in which there is some opacity of the cornea or obstruction in the other media. Beginners may be perplexed by the indefinite criss-cross shadows associated with faint scars on the cornea, the result of past corneal ulceration or of interstitial keratitis. Such confusion can be avoided by careful preliminary examination. Gross corneal opacities are obvious at a glance, but small attenuated nebulae require careful search for their detection.

Corneal opacities

Opacities of the lens are a less troublesome obstacle. If they are mainly peripheral, they will not interfere with the shadow in the centre of the pupil. If, on the other hand, they involve much of the axial portion of the lens, retinoscopy is of far less practical importance,

Opacities of lens

because in such a case it would be impossible to obtain full normal vision with a correcting glass.

Vitreous opacities

Vitreous opacities impede vision roughly in proportion to their number and density, and unless they are so gross as to interfere greatly with vision they do not preclude accurate retinoscopy.

Conical cornea

One of the most puzzling cases for a beginner is an undiagnosed conical cornea, whose swirling shadows conflict with each other and make accurate results impossible. Even in this condition, however, a careful external examination of the eye will probably have drawn attention to something unusual about the cornea.

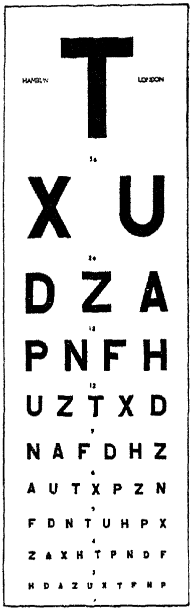


FIG. 60
Snellen's test-types

Subjective testing

Snellen's test-types

Expression of results

A subjective test made upon a patient who is still under a mydriatic will be for distance vision only and is best performed immediately after the retinoscopy. Snellen's test-types of graded sizes are used for this purpose (see Fig. 60). The largest of the letters used should be visible to a normal eye at a distance of sixty metres. In practice, however, the patient is kept seated at six metres' distance. When an eye can see nothing smaller than the largest letter at this distance, vision is described as 6/60. When the second line of letters and nothing smaller is visible, vision is 6/36; and so on down the different sized letters: 6/24, 6/18, 6/12, 6/9, and 6/6. For conventional purposes 6/6 is regarded as normal distance vision, i.e. the eye is capable of seeing, at a distance of six metres, letters which the normal eye is expected to see at that distance. Many people can see the 6/5, 6/4, or even 6/3 lines, for which, theoretically, they would require to be seated at a distance of five, four, and three metres respectively. In small consulting-rooms, which do not permit a distance of six metres, reversed test-types can be hung above the patient's head, and reflected into a mirror situated three metres away, so as to imitate the conditions of a six-metre room. One useful time-saving device is to have the test-types enclosed in such a way that only two or three lines are exposed at a time. By a simple arrangement of pulleys the examiner can easily manipulate the roller which displays the various lines. When vision is expected to approach normal standard, it is best to leave exposed only the 6/12, 6/9, and 6/6 lines, because an unintelligent patient will often insist on reading every line that he can see with each successive glass that is inserted into the trial-frame; and this habit wastes less time if only a few lines are simultaneously on view.

Reversed test-types

The aim of the refractionist should be to obtain 6/6 vision from each eye separately in the absence of any definite reason to the contrary. When he has learnt from his preliminary investigation not to expect a full 6/6 vision from either or both eyes, he will in many instances be able to make a near guess at what lesser standard can be expected. Thus a patient suffering from lens opacities, without any other lesion having been detected, might be expected to see 6/60, or 6/24, or perhaps 6/12, according to the amount and position of the opacities of the lens. The presence of gross lesions at the macula will prevent the observer from undue disappointment at not being able to obtain even as much as 6/60 vision. Occasionally a patient with macular disease, or a considerable amount of opacity of the lens, or some other lesion, will be found to have far better vision than might have been expected. It is therefore unwise to look upon the presence of organic diseases of the eye as an excuse for carrying out the subjective test perfunctorily.

Examination of children

In the examination of children care must be taken to prevent deception. A child with poor vision in one eye will tend instinctively to look over the top or round the corner of a black disc placed in front of the good eye. The black disc should therefore be adequate in size and not separated by too great an interval from the face; moreover the observer should be seated facing the child and watching all the time to make certain that the test is being properly performed.

Emmetropia

If the retinoscopy suggests that the patient is emmetropic, confirmation is obtained by getting 6/6 or better with the aid of a +1·0 sphere in the case of atropinized children, or perhaps only a +0·75 in the case of adolescents or adults under the influence of homatropine and cocaine.

When a refractive error is present, the retinoscopy will have given a clue concerning what lenses may be expected to correct it, and these should at once be put up in the trial-frame.

Astigmatism

If astigmatism is present, the correct angle of the cylinder should be ascertained without delay. When the cylinder has been placed at the expected angle, the patient should be invited to look at one letter of the smallest line that he was able to read. The cylinder is then rotated a few degrees in each direction away from its original position. It should be explained to the patient at the outset that alteration in the test lenses can only have one of three results: a letter must be (i) clearer, (ii) less clear, or (iii) not appreciably changed. The correct angle of the cylinder having been ascertained, i.e. the angle which produces the highest degree of distance vision, small variations in the strength of the sphere and of the cylinder should be tried. If an eye is expected to need a −1·5 sphere, the effects of a −1·25 sphere and of a −1·75 sphere should both be tried. Similar variations are made in the strength of the cylinder.

Duochrome test

Still finer adjustment can be achieved by the duochrome test, in which two lines of letters varying in size are revealed on two differently coloured illuminated backgrounds, one red and one greenish blue (see Fig. 61). An emmetropic person, or a person who has become artificially emmetropic by means of correcting lenses, sees with equal distinctness the letters on the two different colours. If the letters on the red appear the more distinct, the patient is myopic, either by nature or as a result of trial lenses which are relatively too convex. On the other hand, predominance of the letters on the blue-green background indicates hypermetropia, whether real or artificial. In using this test it is important to explain to the patient that here again there are only three possible alternatives: the letters must be (i) clearer on the blue green, (ii) clearer on the red, or (iii) equally clear on the two different colours. What matters is the patient's first impression. If he continues to look backwards and forwards from one to the other, he can cause himself great confusion if he still has active accommodation. In moments of doubt, therefore, he should shut both eyes and describe his impression on first opening them again.

Astigmatic fan

Many refractionists use the astigmatic fan in testing for astigmatism (see Vol. II, Fig. 39, p. 200). This device depends upon the fact that, in uncorrected astigmatism, the radiating lines of the fan appear with different degrees of distinctness in various meridians. There is no doubt that in experienced hands these fans may give good results. It is, however, easy to correct astigmatism adequately without them. If the refractionist succeeds in obtaining from healthy eyes one or two lines' better vision than the normal standard of 6/6, he may feel sure that there cannot be much astigmatism remaining uncorrected. Moreover the fan demands a greater amount of intelligent concentration than most patients have at their disposal; so that, after ten minutes' striving, no information of value may have been gained, and the patient has no reserves of mental energy for the remainder of the subjective test. The beginner should therefore concentrate on accurate retinoscopy and methodical subjective testing on the lines indicated above.

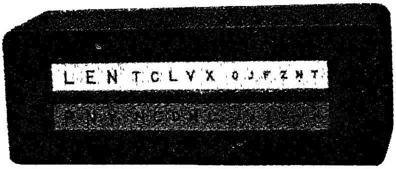


FIG. 61.—Duochrome test for estimation of refractive errors

Post-mydriatic test

Prescription for glasses

After the post-mydriatic test the patient can usually be given a prescription for glasses. According to one rough and ready rule, $-1{\cdot}0$ dioptre should be added to the strength of the lens that gave the best possible distance vision under the mydriatic if atropine was used; and $-0{\cdot}75$ dioptre in the case of homatropine and cocaine. Thus the atropinized eye which required a $+3{\cdot}0$ lens to see the 6/6 line under atropine mydriasis would obtain the same vision by means of a lens of $+2{\cdot}0$ dioptres' strength after the effect of the atropine had worn off. In practice children and adolescents often require a greater subtraction than one dioptre, especially when they have not previously worn glasses. Such people possess large reserves of accommodation, so that a considerable portion of their hypermetropia remains latent for practical purposes. Therefore they are rendered myopic if their full correction is suddenly imposed upon them. The best solution is to prescribe as much as they will tolerate binocularly (in many cases + 0·5 sphere more is tolerated binocularly than was acceptable to each eye singly) at the post-mydriatic test, in the hope that a further addition may be possible after the glasses have been worn for a few months. If, however, there is any question of convergent squint in association with hypermetropia, the full correction, or even more than this, must be ordered, in spite of initial discomfort.

Squint

Myopia

Myopic patients often accept the same correction at the post-mydriatic test as they did during mydriasis. As a general rule they should receive the lowest strength of concave glass that is compatible with their best distance vision. There are still too many refractionists who believe that near work and full correction of the myopic eye tend to augment the myopia, with the result that their myopic patients are deprived of much education and compelled to suffer blurred distance vision, even when they are perfectly capable of good sight and normal intellectual pursuits. Myopic children nearly always become more myopic during the period of growth and perhaps for some time afterwards; but this increase is not prevented by wearing inadequate glasses and by refraining from close work. On the contrary, high progressive myopia is sometimes found in agricultural labourers innocent of glasses.

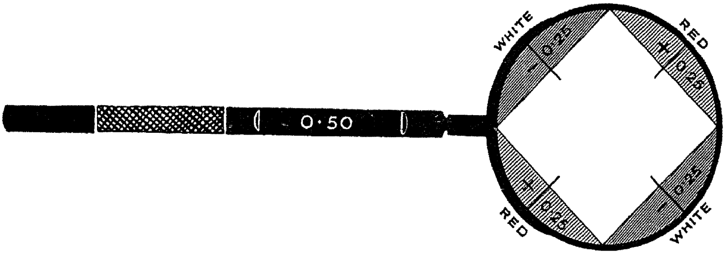


FIG. 62.—Jackson's crossed cylinders

Effect of near work

Astigmatis

The angle of the cylinder to be worn by an astigmatic eye requires careful adjustment. In case of discrepancy between the two observations, the post-mydriatic test should be decisive, if the patient can give consistent answers and appreciate small changes in the angle. Jackson's crossed cylinders, by means of which small additions and subtractions can rapidly and alternately be applied to the supposedly correct cylinder in the trial-frames, are recommended (see Fig. 62).

Glasses for reading

Most patients below the age of forty and many up to forty-five or even a little older should wear the same strength of glasses for reading as for distance; so that, unless there is any reason to suspect some disorder of accommodation, they do not need any prolonged separate test for near work. It is, however, a useful habit for the beginner to ascertain what is the smallest Jaeger type that they can read, and whether they feel comfortable when they look at a type of the size of ordinary newsprint. Myopes of moderate extent will often refuse to read with their full correction when they have previously worn glasses for long distance only.

Correction of presbyopia

Correction of presbyopia is in most people a simple matter. The usual rough guide quoted is that a convex lens one dioptre in strength is required at the age of forty-five, two at fifty, and three at fifty-five or over. In practice this addition errs on the generous side, and there are other factors than age to be considered. From the ideal standpoint it is best to measure the near point, range and amplitude of accommodation in every patient, but for those who wish to neglect these refinements a few practical considerations may be mentioned.

If good vision is obtainable with each eye, it is hardly ever necessary, even in very old patients, to give a presbyopic correction of more than 3·0 dioptres. A monocular patient may need 3·5 or even 4·0 dioptres. People who wish to do fine embroidery, mount moths, or do some other form of detailed work may need up to 4·0 dioptres, as may patients with much lens opacity or any other disability that compels them to work at closer range than normal. Tall people tend to hold books further away than short people, and will therefore need a weaker glass than might otherwise be expected. Healthy vigorous emmetropes, especially if they live much in the open air, often feel no need for reading-glasses until about the age of fifty, and will certainly be made uncomfortable if they are suddenly ordered +1·75 spheres. Presbyopia is more often over- than under-corrected, and over-correction entails active discomfort far less tolerable than the slight disability of a moderate under-correction. One of the most important things to bear in mind is the distance at which the patient wishes to use his glasses. If a considerably presbyopic person wishes to be comfortable for reading at fifteen inches' distance, as well as for watching cards or a music-score at a distance of perhaps two and a half feet, he must have glasses of different strengths for the two different purposes.

3.–REFRACTION WITHOUT MYDRIATIC

Advantages

From the average patient's point of view there are three great advantages in retinoscopy without a mydriatic: (i) only one attendance is needed instead of two; (ii) the test can be performed forthwith, instead of waiting for drops to take effect; and (iii) the discomfort of drops is avoided. Refraction with a mydriatic, on the other hand, is essential for the inexperienced refractionist who wishes to lay a proper foundation for his work. In spite of the need for two attendances instead of one, the average time per patient is usually longer when a mydriatic is avoided; drops are therefore indicated when a large group of patients must be tested within a limited time. A mydriatic certainly makes the work easier and quicker from the refractionist's point of view, but, granted the necessary experience and time, it is better, for the sake of the patient, to carry out the refraction without using drops. Retinoscopy through the undilated pupil is more difficult than with the dilated pupil, apart from the fact that fallacies of interpretation are probable in young patients with active accommodation. The best way to become more skilful in this direction is to make a habit, in the first year or more devoted to refraction, of performing a rapid retinoscopy on all the patients who come for a post-mydriatic test. In this way the observer can check his own retinoscopy under a mydriatic with that which he finds when the eyes have reverted to their normal condition. He has the additional advantage of being able to compare both these results with that of the subjective test. After a few hundred patients have been thus examined, he will be far better qualified to interpret his figures.

Technique

The most convenient plan for refraction without a mydriatic is to have the patient seated at six metres from the distance test-types in a large room which can be completely darkened. Otherwise time is wasted and inconvenience caused by moving to and from a small dark-room. Moreover, a better relaxation of accommodation is obtained when the patient is given a definite object six metres away towards which he must direct his gaze, rather than being merely told, in the confined space of a small dark-room, to look vaguely into the far distance. An external inspection is first made with some form of hand slit-lamp or, failing that, with a special torch from which light can be concentrated to a focus. The size and reactions of the pupils and the range of the ocular movements can be noted at the same time. The patient should then look towards the outstretched little finger of the observer's hand holding a Priestley Smith ophthalmoscope (see Fig. 63) or some similar instrument, through the sight-hole of whose plane mirror the observer gazes at the patient's pupil from a distance of about one metre. Thus he obtains a great deal of information about the state of transparency of the media of the eye and makes an approximate estimate of the refraction. As the patient's eye moves in various directions, certain gross fundus changes, e.g. detachment of the retina, may be indicated.

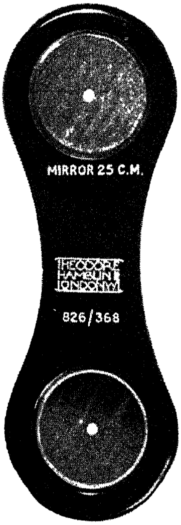


FIG. 63
Priestley Smith ophthalmoscope

External inspection

Ophthalmoscopy

Retinoscopy

The next important step is ophthalmoscopy, both by the indirect and direct methods. Then follows retinoscopy without a mydriatic, for which a trial-frame should be fitted on the patient. The patient should be told to look at a small illuminated bulb at the other end of the room, somewhat to one side of the observer, to discourage, as far as possible, contraction of the pupil to accommodation. He should be instructed to ignore the illuminated mirror which is about to be held up one metre in front of him. Young patients often find it easier to relax their accommodation if they are asked to look slightly over the top of the distant light and to imagine that they are looking at ships far away or mountains on the horizon.

Most refractionists use spheres for retinoscopy, but good results can be obtained from cylinders in addition. The choice of method is in itself of far less importance than the experience which each observer can gain by checking his own results, as indicated above, in a large series of cases.

Subjective test

Retinoscopy having been completed, a subjective test is performed on each eye separately, a black disc being placed in front of the eye which is not being tested for the moment. In front of the uncovered eye are placed whatever lenses may be indicated by the results of retinoscopy. Closer adjustments can then be made in the way that has already been detailed above in describing the subjective test under a mydriatic. Presbyopes receive the appropriate addition to their distance glasses, as in a post-mydriatic test.

Children

Whenever there is any question of concomitant squint, whether constant or intermittent, in a child, refraction without a mydriatic is undesirable.

Similarly, a child with any considerable error of refraction should be atropinized, especially if myopic. Some authorities maintain that no estimation of a child's refraction is permissible without a mydriatic. This point of view is too extreme if it is literally applied to every child who is brought merely for a precautionary test during the early years of school attendance. If a child has full normal vision, both distance and near; normal fundi and media; is free from symptoms of eye strain or any history of squint; and if retinoscopy through the undilated pupil points to the probability of emmetropia; then there is no good reason for interrupting normal pursuits by mydriasis and paralysis of the accommodation lasting two or three weeks.

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REJUVENATION

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2. ENDOCRINE TREATMENT OF PREMATURE SENILITY - - - - - - 582

Reference may also be made to the following titles:

SENESCENCE AND SENILITY
SEX HORMONES
STERILITY

1.–REJUVENATION OPERATIONS

(1)—Rationale of Operations

1359.] The rejuvenation operations introduced since 1919 are all based on the assumption that senescence is associated with a diminished activity of the gonads, and that it can be combated in the male by any measure that increases the amount of male hormone in the body. This idea is far from new; old age is generally accompanied by a loss of sexual desire, and there is some superficial resemblance between the changes produced by castration and those occurring naturally in old age. The eunuch resembles an old man, not only in his diminished interest in sex, but also in his loss of hair, his tendency to put on weight, his slow gait, and his placid temperament. It is therefore not surprising that the idea arose that the physiological basis of the two conditions was the same. Brown-Séquard's observations, made on himself in 1889, strengthened this view. Faced with the prospect of having to give up his work on account of ill-health and old age, he gave himself injections of an extract of dogs' testicles. This treatment, apparently, had such a beneficial effect on his health that he was able to resume his work in

Brown-Séquard's experiments

the laboratory and to carry on his experiments for several years longer. Others repeated Brown-Séquard's experiments with extracts of testicle, but with varying success, the degree of success attained depending to some extent on the mode of preparation of the extract.

Steinach's experiments

Interest in Brown-Séquard's observations was revived by the writings of Steinach, who in 1920 claimed that what Brown-Séquard had achieved with extracts could be attained by a much simpler method, namely, bilateral ligature of the vas deferens, and that by this trifling operation the output of hormone from the testicle could be increased. These observations recalled those made by Ancel and Bouin, that ligature of the vas in young animals produced a state of heightened sexual vigour. The chief difference was that Steinach's experiments were done on old animals, and that he claimed that the ligature not only revived sexual desire but also resulted in a general increase in bodily vigour. For his original experiments he selected senile rats, an animal particularly well suited to his purpose because the life of a rat is short and symptoms of age are easily recognizable.

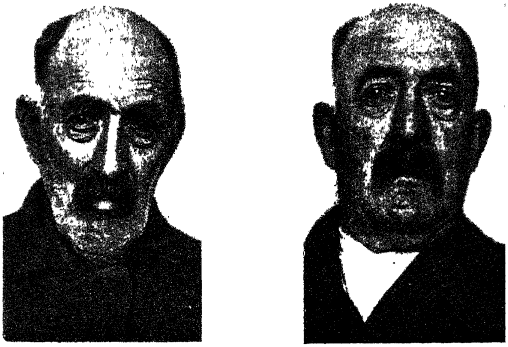

FIG. 64.—Before and some months after testicular grafting (Voronoff). This, and Figs. 65 and 66, from *Diseases of the Testicle*, by H. Bailey

Voronoff's experiments

About the same time Voronoff also attempted to increase the output of male hormone in the body of old animals, but by another method, namely, the implantation of testicular grafts. Having obtained what he considered positive results in animals, he extended his work to human beings. Here the chief obstacle was the difficulty of obtaining material for grafts. The supply of human testicle being very limited, it was necessary, if the work was to be carried out on a large scale, to have recourse to animal donors. The implantation of grafts from lower animals into man had been proved to be unsuccessful, owing to frequent failure of the graft to vascularize. The closer relationship between anthropoid apes and man suggested that the chance of survival of heterografts would be greater if they were obtained from such a source. He therefore employed the male chimpanzee as a donor and claimed to have obtained excellent results (see Fig. 64).

(2)—Steinach Operations

Technique

The original Steinach technique consisted merely in exposure of the vas at the neck of the scrotum, its isolation from the other constituents of the cord, and its division between ligatures. The operation can be carried out under a local anaesthetic, and the only important point is that, in the separation of the vas, care should be taken to avoid interference with the blood-supply of the testis. There may be slight swelling and tenderness of the testes for a few days after the operation, and when he gets up the patient should wear a good suspensory bandage. The Steinach operation is identical with that which is more fully described in the article STERILIZATION.

Niehans' modification (Steinach II)

In 1931 Niehans began to use what is known as Steinach's second operation for the treatment of prostatic enlargement. This operation, which is sometimes now called the Niehans operation, was actually used previously by Steinach in his laboratory experiments on animals. It consists in ligaturing the efferent tubules of the testicle (see Fig. 65) and, because the ligature is on the distal side of the epididymis, has the advantage of avoiding swelling of that structure. Niehans reported excellent results from this procedure, and claimed that it improved not only the prostatic condition for which it had been carried out but also the general health and vigour of the patient.

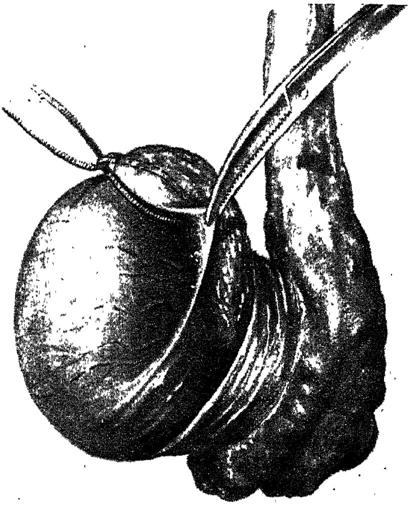

FIG. 65.—Steinach II operation, showing strong silk ligature passed through digital fossa and tied so as to occupy the groove between the globus major and the body of the testicle

Technique

A two-inch incision is made over each external abdominal ring, and the spermatic cords are exposed. The testicle is brought into the wound by pressure from below, and the tunica vaginalis is opened. A strong silk ligature is then passed through the digital fossa and tied so as to occupy the groove that normally exists between the globus major and the body of the testicle. The ligature is so placed that it occludes all the vasa efferentia as they pass out of the rete testis. Steinach II has been particularly advocated by Niehans as a method of treatment for prostatic enlargement (see p. 155).

(3)—Voronoff Operation

Technique

The grafts are implanted within the tunica vaginalis. This being the normal environment for testicular tissue, Voronoff believes that grafts are more likely to survive and to flourish in this situation than when they are inserted, as advocated by some surgeons, into a muscle, e.g. the rectus. The bed for the grafts is prepared as follows. Each testis is delivered in turn through a suitable incision in the scrotum, and the visceral surface of the tunica vaginalis is then lightly scarified with a needle in the situations in which it is proposed to insert the grafts (see Fig. 66). The next step in the operation is the preparation and shaping of the grafts. The donor is a young chimpanzee, whose blood has previously been tested for spirochaetosis. After the donor's testis has been delivered, the epididymis is removed and the whole testis divided so as to obtain four wedge-shaped slices like those of a melon. The sharp edges are then trimmed with scissors. The tunica albuginea covering the grafts is then scarified, to facilitate subsequent vascularization. Two grafts are then implanted into each tunica vaginalis in the situations already prepared, placed so that the testicular tissue is in close contact with the scarified areas of the tunica vaginalis, and fixed with fine catgut sutures. The grafts must be firmly secured, and there should not be any contact between two neighbouring grafts, as this is likely to cause necrosis. The parietal layer of the tunica is then sutured and the scrotal wound closed without drainage. In order that as little time as possible should be taken in effecting the transplantation, while Voronoff is preparing the site of implantation an assistant removes aseptically the chimpanzee's testis. According to him, three months must elapse before any beneficial effects can be expected. He believes that the grafts survive for three or four years; the operation can then, if desired, be repeated.

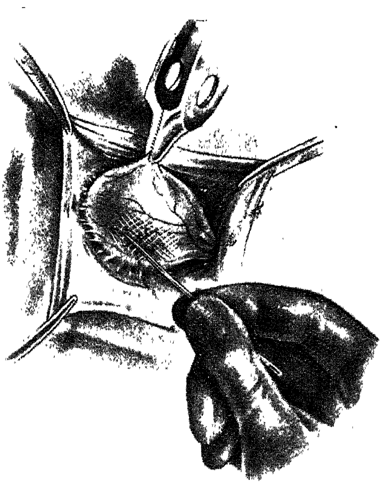

FIG. 66.—Voronoff operation: scarification of visceral layer of tunica vaginalis in preparation for application of graft (after Voronoff)

(4)—Results of Operations

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sychological
actor

It is extremely difficult to assess the results of a rejuvenation operation owing to the strong psychological effect that this always exerts on the patient; having had sufficient faith to undergo the operation, he is only too likely to imagine that he has benefited, and there are few objective signs on which to base a judgement. It may be objected that this is only true of human beings and does not apply to Steinach's animal experiments, but here other factors may have come into play; it has been suggested that the rats operated upon by Steinach benefited from the care they received after the operation, and that it is possible that the improvement in weight and vigour was due to better hygiene and diet rather than to the operation.

The records published by followers of Steinach and Voronoff show marked variation in the results, some claiming a large percentage of successes, others reporting only a few. According to Peter Schmidt, who has followed the Steinach technique, the improvements most constantly found are an increase of appetite and a return of muscular and mental vigour. The same claims are made for the Voronoff operation, not only by its originator but by Lichtenstern and other surgeons.

Vaso-ligature

I have carried out rejuvenation operations in about one hundred cases, seven with the Voronoff technique and the rest according to the Steinach method, but can express only a very guarded opinion of the results obtained. Even the theoretical basis of the Steinach operation, namely, the idea that ligation of the vas or efferent ducts increases the output of male hormone, cannot be regarded as completely proved. The fact that the interstitial cells of Leydig are more obvious in sections of testes after ligation does not necessarily mean that there is an increased output of hormone. The source of the male hormone is still a controversial question; some believe that the interstitial cells of the testis do not form it but merely store nutritive material that is later taken up and utilized by the tubules. The testis of an animal with a rutting season, e.g. a mole, consists mainly of interstitial cells before breeding begins, only a few rudimentary tubules being then present. Later in the year, at the time of rut, a great change has taken place; the tubules have increased enormously in size, and the interstitial cells have almost disappeared. This suggests that the interstitial cells have acted as a storage house of material to be utilized during the period of sudden development and activity of the tubules.

The value of the Steinach operation must be judged on practical, rather than on theoretical, grounds. Does ligature of the vas or efferent ducts, in suitable cases, result in an improvement in health? There can be no clear answer to this question. Sceptical though I may be about the rationale of the procedure, I have seen patients who were convinced that they had benefited from ligature and denied the possibility that their improvement could be explained by auto-suggestion. This denial, however, cannot be taken as a proof that psychological factors were not responsible for the benefit to health.

In this country it has been impossible to follow Voronoff's technique exactly, owing to the fact that chimpanzees cannot be used as donors. I therefore in the past utilized ectopic testes which it had been found necessary to remove from patients. This course was adopted in seven cases, but in no instance were the results even as convincing as those obtained from the simpler Steinach operation. Grafts, even if they become vascularized, are rapidly absorbed, and in my opinion Voronoff's claim that they may survive as long as three or four years has not been confirmed. It is therefore difficult to understand Voronoff's statement that, in cases in which it has been possible to examine a graft some years after its insertion, not only has the graft been intact, but in one instance in which a very young donor was employed the tubules had developed and spermatogenesis was present.

Effect on duration of life

Other critics of the Steinach and Voronoff operations have asserted that, even although they may bring about a temporary increase in bodily and mental vigour, their action is merely that of spurring on a tired horse. The final result will therefore be that the patient, after enjoying a short period of increased health, will die sooner than he otherwise would. Steinach and Voronoff, however, both state that this is not the case, and that not only is the quality of life improved but also its duration. Wiesner, who carried out vaso-ligature in rats, found that their average duration of life was slightly less than that of control animals.

2.–ENDOCRINE TREATMENT OF PREMATURE SENILITY

Male hormone

1360.] Treatment by injections of testicular extract has met with very little success until recently. The sex glands continually yield up their secretion to the blood-stream and do not store it; an extract of the gland therefore contains only traces of hormone. The extraction by Butenandt in 1931 of androsterone from the urine and the synthesis of pure male hormone by Ruzicka and others from cholesterol have, however, entirely altered the situation, and have provided clinicians with an active preparation of male hormone. Injections of male hormone have been given for various clinical conditions, namely, premature exhaustion, insomnia, inability to concentrate, impaired memory, mental depression, and loss of potency and libido in middle-aged men. There is reason to believe that the male, like the female, passes through a phase of endocrine instability at a certain period of his life. During this period he may receive as much benefit from administration of testicular extract as the female does from the use of ovarian products. The improvement from the testosterone therapy will depend upon the extent to which the gonads are responsible for the symptoms, but it is often worth while putting the patient on small doses of the testicular extract, although there is no direct evidence of testicular deficiency. Doses of 5 to 10 mgm. of testosterone propionate weekly by intramuscular injection are sufficient, and sometimes unexpectedly good results follow.

Thyroid

The only other endocrine preparation which has been tried in similar cases is dried thyroid. When given for this purpose, only very small doses, ½ to 1 grain twice daily for two or three weeks, need be employed. If this fails, thyroid therapy may be combined with injections of male hormone.

Steinach suggested that the male hormone acted by relaxing the blood-vessel walls, and that the benefit was mainly due to vasodilatation of the cerebral vessels. A more probable explanation is that the administration of any active endocrine preparation may provide a fillip to the whole of the endocrine circle, causing a general increase in metabolism and a feeling of increased well-being.

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RELAPSING FEVERS

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Reference may also be made to the following titles:

ARTHROPODS AND DISEASE
TYPHUS FEVERS

1.–DEFINITION AND CLASSIFICATION

Definition

1361.] The name relapsing fever is used as an inclusive designation for two closely related but distinct fevers. Both have a pronounced tendency to relapse, and both are caused by special spirochaetes which are conveyed to man in one case by lice and in the other by ticks. Some experts believe that the spirochaetes of the two kinds of relapsing fever are different strains of the same species rather than distinct species. But from the point of view of the practitioner and the public-health worker, the two fevers differ from each other in such important respects that confusion results from attempts to describe them under one heading. The term 'the relapsing fevers' is therefore more suitable than 'relapsing fever'. So also the two causal spirochaetes can be regarded, provisionally, as belonging to two species (see p. 593).

*Classification of the re-
apsing fevers*

For practical utility the following provisional classification of the relapsing fevers is proposed:

	Epidemic Relapsing Fever or Louse Relapsing Fever	Non-Epidemic Relapsing Fever or Tick Relapsing Fever
Causal organisms	*Spirochaeta recurrentis* (Synonyms—*Spirochaeta obermeieri, Treponema recurrentis, Spironema recurrentis, Borrelia recurrentis*)	*Spirochaeta duttoni*
Vectors – –	Human lice	Various ticks
Modes of transmission	Direct from man to man	From lower animals to man or from man to man
Epidemiology –	Occurs mostly in epidemics	An endemic and sporadic disease
Clinical features –	One to three spells of fever, rarely more	Rarely less than four spells of fever

Provisional nature of classification

A reservation should be made with regard to the preceding classification. There is no certain proof that the spirochaete of tick relapsing fever is never transmitted naturally by lice or the spirochaete of louse relapsing fever by ticks. All that can be asserted is that the observations made hitherto strongly support the view that the two diseases retain their special features in a very uniform manner under natural conditions and so may be provisionally regarded as distinct entities.

2.–LOUSE RELAPSING FEVER OR EPIDEMIC RELAPSING FEVER

Definition

This is the historical or classical form of relapsing fever; it is a febrile disease caused by a specific spirochaete (*Spirochaeta recurrentis*) which is conveyed from man to man by lice and therefore tends to spread rapidly in epidemics among louse-infested communities. In most cases there are one or more relapses, though there may only be a single spell of fever.

History

Although the disease was described by Hippocrates, until about a century ago it was regarded as a form of typhus fever. In 1868 Obermeier discovered the spirochaete. In 1882 Münch in Moscow and Carter in Bombay independently proved that the disease could be transmitted to man by injection of the blood of infected persons. In 1907 F. P. Mackie in India incriminated the louse as the probable vector. In 1913 Nicolle, Blaizot, and Conseil demonstrated the transmission of the disease by lice.

Epidemiology

Conditions favouring spread

Like louse-borne typhus, the disease tends to occur in epidemics among louse-infested people. Susceptibility is greatly increased by under-nourishment; overcrowding is also specially favourable to the spread of infection, so that jails and other institutions are liable to be affected. In good hygienic conditions the disease cannot spread, so that it has practically vanished from the progressive western countries where formerly it was very prevalent. During and after the War 1914–18 conditions were very suitable for its spread, and great epidemics swept over Eastern Europe.

Periodicity of epidemics

In countries where the people are louse-infested epidemics are liable to occur at intervals of several years. The usual chain of events is that the disease, when introduced into a locality, rapidly increases for two or three years and then gradually disappears or remains in a few isolated foci; after an interval of a few years it is liable to flare up again. An epidemic seems to create such a degree of mass immunity that the disease dies out until susceptibility in the community again becomes sufficient to allow of the spread of infection from person to person.

Aetiology

Geographical distribution

The geographical distribution varies greatly from time to time but, broadly speaking, all louse-infested countries are liable to be invaded by the disease. Australasia has hitherto remained free from relapsing fever. The range of distribution is wider than that of epidemic typhus fever; for example, in large areas of Africa and India which have never been known to be invaded by louse-borne typhus there have been great epidemics of louse relapsing fever in recent years. The countries which have been most seriously affected during the past twenty-five years are Russia and the other countries of eastern Europe, northern Asia, Asia Minor, northern and equatorial Africa, and India with the exception of the greater part of Bengal, Assam, and Orissa. Lesser outbreaks have occurred in several other countries, such as Peru in South America, but in America generally the tick-borne variety of the disease seems to preponderate.

Seasonal distribution

During the cold season the disease tends to increase; its greatest prevalence is often in the early part of the hot season, when the louse population has reached its maximum in both numbers and activity. With the establishment of hot and dry weather the disease usually dies down rapidly and remains at a low level till the following cold season. This type of seasonal distribution, though usual, is by no means universal.

F. W. Cragg observed that epidemics in the United Provinces of India occurred only when the previous cold season had been unduly prolonged by the occurrence of exceptionally low temperatures during the months of April and May. Normally the louse population would be greatly reduced during these hot and dry months, so that the transmission of infection from sporadic cases would be arrested; whereas, if April and May remained cool, the season of transmission would be prolonged, and numerous foci of infection would persist till the onset of the following cold season, when conditions again become favourable for the transmission of the organism. According to Cragg the United Provinces had epidemics in the years 1862, 1878, 1891, 1906, and 1920.

Age and sex distribution

Males are more frequently attacked than females. Young children are relatively exempt, probably because their soft fingers are not effective in crushing lice and in causing the skin abrasions through which the infection usually enters the body.

Bacteriology, morbid anatomy, and pathology

Causal organism

Although several strains of spirochaetes have been isolated from cases of louse relapsing fever and different names have been given to these, there is no satisfactory evidence of the existence of more than one true species, namely, the *Spirochaeta recurrentis*. The strains differ from each other in certain respects, such as their agglutination reactions, but similar differences have been found between spirochaetes isolated during separate spells of fever from one and the same case, so that there is no justification for regarding minor laboratory differences as evidence for the existence of several distinct species.

Strains

It has been suggested that the tendency of the disease to relapse is explained by the occurrence of two or more strains of spirochaetes in the relapsing cases. For example, if three strains, A, B, and C, were present originally, and if strain A were to predominate in the first spell of fever, immunity would be established against this strain but not against the other two. Then, if strain B were to predominate in the first relapse, immunity would be built up against this strain also, so that only strain C would remain capable of multiplying and causing the second relapse.

Morphology

The spirochaete is an exceedingly slender spiral and varies from 2μ to 30μ in length: in human blood its length is usually between 10μ and 20μ, and it has three to six turns. It is sharply pointed at both ends. It can be stained by Leishman's or Romanowsky stains; when present in small numbers in the blood, thick films are necessary for its detection. Some workers prefer to examine moist films by dark-ground illumination, because the active motility of the spirochaetes is a great help in their detection. They can usually be found in the peripheral blood during febrile attacks but disappear rather rapidly when the temperature falls, sometimes even before the crisis. They can be cultivated in various modifications of Noguchi's medium, preferably under a layer of liquid paraffin. Monkeys are readily inoculable, but other animals are resistant to direct inoculation, although laboratory animals can be inoculated by a strain which has first been passaged through a monkey.

Susceptibility of animals

Immunity

For a short time after an attack there is complete immunity, but second attacks sometimes occur within a few months. The tendency of the disease to die down after being highly prevalent in a locality for two or three years suggests that a severely affected community acquires mass immunity against the infection.

The spirochaetes soon disappear from infected blood which has been

Transmission of the organism

swallowed by a louse, but after 5 to 15 days they are found in large numbers throughout its body. Infection is rarely, if ever, conveyed directly by the bite of the louse, but, when the body of the insect is crushed by the fingers, the spirochaetes enter the body through the abrasions caused in the act of scratching or through the puncture caused by the louse in biting.

The louse becomes capable of conveying infection by the fifth to the fifteenth day after biting an infected person and remains so till the end of its life. Transmission of the organism to the offspring of infected lice is of very doubtful occurrence. Direct mechanical transmission of the spirochaetes by the biting parts of lice, bugs, or fleas may possibly occur rarely, but this mode of transmission must be of little importance.

Morbid anatomy

The spleen is usually large and soft. The skin may be jaundiced and show petechiae. The spirochaetes rapidly disappear from the blood after death, even when this occurs during the febrile period, but they may be found for some time after death in the endothelial cells of the spleen and liver.

Spirochaetes in blood

The blood changes are of special importance, because the presence of spirochaetes is the only certain diagnostic feature in the early stages. They are found from the onset of the fever, increase in numbers during the first two or three days, and usually disappear rapidly with the fall of the temperature (see Fig. 67, A). Between the spells of fever the spirochaetes can rarely be seen, but, as the blood is still infective, the parasites must still be present either in very small numbers or in the form of 'infective granules', the existence of which as a developmental phase of the parasites was assumed by Leishman. Spirochaetes reappear during the relapses, but usually in smaller numbers. In exceptional cases the spirochaetes disappear some time before the fall of the temperature; a negative finding towards the end of the spell of fever does not therefore justify the exclusion of the disease. There is usually an increase in the total leucocytes, especially the large mononuclears.

Leucocytes

Urine

The urine has the usual febrile changes; it may contain albumin with granular or hyaline casts. Spirochaetes have been found occasionally in the centrifugalized deposit.

Clinical picture

Incubation period

Onset

The incubation period is usually six to ten days, but periods varying from two to twelve days have been recorded. After prodromes, such as are common in other acute fevers, there is a sudden or rapid onset, often with shivering, headache, and body pains, sometimes also with nausea or vomiting. The temperature rapidly rises to 102° to 104° F., and at this stage spirochaetes can usually be found in the blood. The fever is usually of the continued type, but pronounced remissions may occur. The face is often flushed, and the eyes injected. The spleen and liver are usually enlarged and tender in severe cases. Jaundice occurs in 20 to 60 per cent of the cases in severe epidemics. Bronchitis with hurried breathing and cough is common (40 to 60 per cent of cases in some outbreaks). Epistaxis has been observed in 5 to 30 per cent of cases in various epidemics.

Termination of first fever spell

After 4 to 9 days (usually 6 to 8) the temperature falls by crisis or by rapid lysis with sweating; a tendency to collapse is often observed,

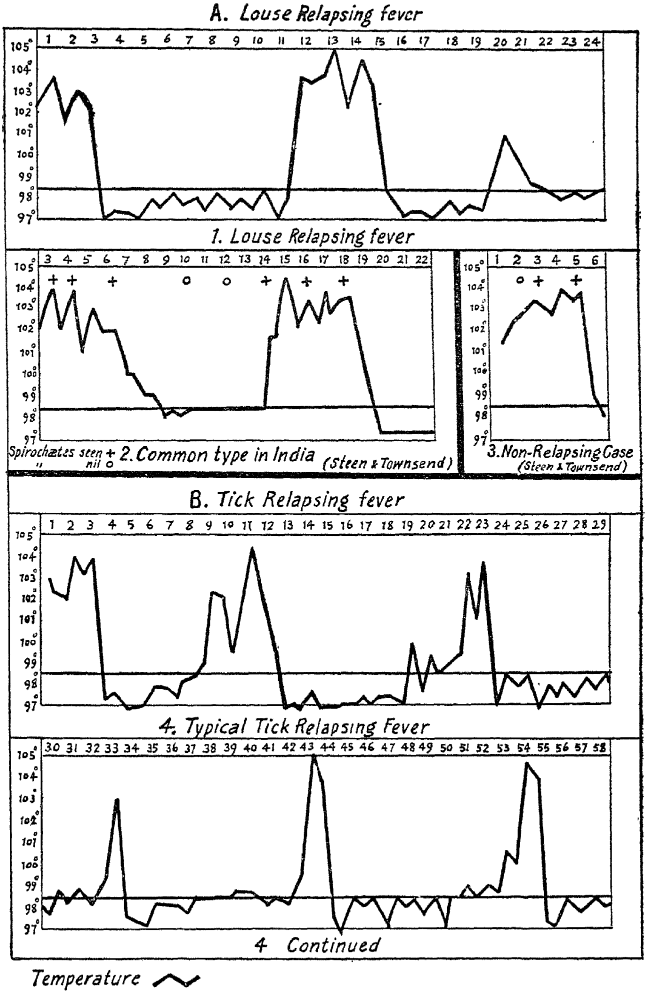

FIG. 67.—Temperature chart of louse and tick relapsing fevers. (From *Tropical Medicine*, by L. Rogers and J. W. D. Megaw)

Fever-free interval

and the temperature usually becomes subnormal for a day or two (see Fig. 67, A). The liver and spleen now return to their normal size, and the symptoms which accompanied the fever disappear. The patient's general condition begins to improve to some extent.

Relapse

Second and third relapses

In most cases a relapse very similar to the first spell of fever sets in on the eleventh to the fifteenth day after the onset, most commonly on the twelfth or thirteenth day. The second spell of fever is usually shorter and less severe than the first, but exceptionally it is more severe and of longer duration. The symptoms are similar to those observed in the first spell of fever, but symptoms which have not appeared in the first spell may appear during the second. For example, jaundice may occur for the first time during the relapse. A second relapse, usually milder than the first, is seen in some cases after about the same interval as has elapsed between the onset of the first spell of fever and the first relapse. Rather rarely there is a third relapse.

Incidence of relapses

Circulatory system

Rash

Eyes

The number of relapses varies greatly in different epidemics; in some outbreaks as many as 50 per cent of the patients do not relapse at all, so that several cases may be seen at the outset of an epidemic in which this striking feature of the disease is absent. From 25 to 65 per cent of the patients have one relapse, 10 to 40 per cent have two relapses, and only 1 to 2 per cent have three or four relapses. Apart from a tendency to heart failure during or after the crisis and an occasional relative slowness of the pulse, there is nothing specially noteworthy in the circulatory system. In white-skinned patients a macular rash or rose spots may be seen in some cases, but in pigmented skins a rash is rare. Photophobia and injection of the conjunctivae are common. Iritis is seen in about 3 per cent of the cases.

Pains

The pains are much the same as those of dengue and influenza: in some outbreaks severe pains in the shins occur in a large number of patients.

Diagnosis and prognosis

The detection of the spirochaetes in blood films constitutes a certain method of diagnosis in the great majority of cases. During an epidemic there is seldom any difficulty in diagnosis, though it is always necessary to bear in mind that other fevers may occur during an outbreak of relapsing fever, and therefore to insist on the microscopical diagnosis of each case. Regrettable failures to recognize the disease have often occurred at the beginning of outbreaks even in institutions where there were ample opportunities for observing the patients. The reason for these mistakes is that suspicion of the nature of the disease was not aroused. Although the spirochaetes are unmistakable *when looked for* in a properly stained specimen, they are often missed when the blood is being examined for malarial parasites or for some other purpose.

Examination of blood films

The first essential in diagnosis is therefore to suspect the disease and to search for the spirochaetes. Thin or thick films stained as for malaria parasites are quite satisfactory, but some workers prefer the dark-ground illumination of moist preparations; Indian ink preparations are also suitable. As the spirochaetes are rarely found during the non-febrile periods, and exceptionally are absent even during fever, it may sometimes be necessary to resort to the inoculation of monkeys.

If proper temperature charts are kept, the nature of the disease will soon become obvious, at any rate when several cases are under observation. The earliest cases are often missed when they happen to be of the non-relapsing type.

Differentia diagnosis

Differential diagnosis need hardly be discussed in connexion with a disease in which an absolute diagnosis is usually possible. When the disease is not detected, the fever is often wrongly attributed to dengue, malaria, enteric, typhus fever, or broncho-pneumonia.

Mortality

Remarkable variations in severity have been recorded. In some outbreaks the case mortality may be as low as 1 per cent; in others it may rise to 70 per cent, the average being probably between 3 and 10 per cent in otherwise healthy adults. The death-rate is influenced chiefly by the state of nutrition and age of the patients, the virulence of the infection, and the treatment adopted. Among ill-nourished unhealthy and overcrowded groups of people the disease may be terribly fatal; in some areas as many as 30 per cent of the entire population have died in an epidemic. As a general rule the more numerous the spirochaetes the more severe is the attack, but the general condition of the patient is a far better guide than the number of parasites. The age of the patient is important; the older he is the worse his prospect of recovery. The prompt injection of neoarsphenamine or other suitable arsenical may be expected to improve greatly the patient's chances of recovery, but no reliable data are available on the subject. In debilitated persons in the grip of a virulent form of the disease it remains to be seen whether the specific treatment will do much to increase the chances of recovery. On the other hand, outbreaks of considerable dimensions have been recorded in which no deaths have occurred despite the absence of any specific treatment.

Treatment

Protection from lice

Prevention is based on the simple principle that epidemic relapsing fever cannot exist in the absence of lice. Practitioners, nurses, and attendants are exposed to serious risk so long as the patients still harbour lice. Special louse-proof overalls should be worn on duty and should be removed and sterilized after each spell of attendance on the sick. It is advisable for everyone to take a hot bath using plenty of germicidal soap after each period of exposure to risk. After the bath a little olive oil or expressed oil of mustard should be rubbed into the skin and hair. Oil is a valuable deterrent of lice, so that it is a useful precaution to keep the skin and hair well oiled. The addition of a little kerosene (paraffin oil) to the lubricant is desirable when exceptionally great risks must be run. All patients should be freed from lice by bathing them with soap and water, shaving all the hairy parts where possible, applying oil to the skin and hair, and disinfecting all clothing and bedding by a steam or hot-air disinfecter. Soaking the clothing for half an hour in a 5 per cent solution of lysol and then washing in the ordinary way is also effective. In dealing with large numbers of people it is necessary to provide de-lousing stations where the people are bathed and disinfested while their clothing and bedding are undergoing suitable treatment. Clothing can be readily freed from lice and nits by the thorough application of a hot iron. The management of de-lousing stations on a large scale calls for special training of operators: the methods to be employed depend on local conditions. In warfare the prevention of louse infestation among the troops forms a very important part of the military arrangements; an army may suffer heavily in efficiency if relapsing fever and typhus are not kept in check.

General treatment

The general treatment is on lines suitable for any debilitating acute fever; the patient is kept in bed and is given a nourishing liquid diet.

Feeding

The patients are often under-nourished and may be greatly in need of vitamins, especially vitamin C. No attempt should be made to overfeed the patients, especially at the height of the fever, but milk and fruit juice, if tolerated, should be given. Plenty of water is necessary, and the patient should be made to drink this at regular intervals if he is apathetic and does not call for water. Great care should be taken to prevent the patient from exerting himself during the first few days after the fall of the temperature.

Specific treatment

A dose of 0·4 gram of novarsenobillon is given very slowly intravenously to patients of 160 lb. weight, the dose being reduced or increased in proportion to the body-weight. The dose should be given during the early stage of the fever, never at the crisis or when the crisis is likely to be imminent; otherwise dangerous collapse may follow. When spirochaetes are numerous in the blood, the drug is likely to be specially effective; if they have disappeared, it is better to wait till they reappear.

Contra-indications to neoarsphenamine

In co-existing disease of the cardiovascular, hepatic, or renal system the drug is dangerous; when the patient is seriously prostrated, powerful drugs may do more harm than good.

In suitable cases the attack is often cut short by arsenicals and, even if a relapse occurs, a second dose will probably prove effective. If neosalvarsan is used, the dose should be rather smaller, namely, 0·3 gram for a patient of 160 lb. These doses are smaller than those ordinarily recommended, but the drugs are toxic, and the patients are often so debilitated that large doses may easily do more harm than good.

3.—TICK RELAPSING FEVER OR NON-EPIDEMIC RELAPSING FEVER

Definition

1362.] This is a form of relapsing fever caused by the *Treponema* or *Spirochaeta duttoni*, which is transmitted by certain species of ticks from animals to man or from man to man.

The disease differs from louse-borne relapsing fever in so many important respects that it must be described as a distinct entity (see p. 584).

In 1903 Christy described the disease in East Africa. In 1904 Ross and Milne discovered spirochaetes in the blood of patients in Uganda. In 1905 Dutton and Todd independently showed that a tick (*Ornithodorus moubata*) could convey the disease by its bite, and that the infection could be transmitted from ticks to their offspring. *History*

Some of the differences between the organisms of tick relapsing fever and louse relapsing fever are as follows. Some authorities regard the spirochaetes of tick relapsing fever and louse relapsing fever as varieties of one species, namely, *Spirochaeta recurrentis*, but in view of the clinical and experimental differences in the behaviour of the two spirochaetes it seems preferable to regard them as distinct though closely related species, namely, *Spirochaeta recurrentis* and *Spirochaeta duttoni*. On the other hand, there can be little justification for employing a large number of separate names to designate the spirochaetes isolated from cases of tick relapsing fever in different localities. Some of the names in use are *Spirochaeta hispanica*, *Sp. normandi*, *Sp. sogdiana*, *Sp. kochi*, *Sp. rossi*, *Sp. crocidurae*, *Sp. novyi*, *Sp. venezuelensis*, and *Sp. neotropica*.

The disease is essentially a sporadic 'place' disease which persists indefinitely in certain areas where the local fauna are infected. Camping-grounds and rest-houses are foci of infection, being often infested by ticks, which are liable to become infected either by human occupants or by local rodents. The disease is common in young children, to whom infection is conveyed without the necessity for crushing the vector with their fingers. *Epidemiology*

The disease has a very wide but patchy distribution. Most Mediterranean countries are affected, especially those in North Africa. There are known foci of infection in tropical Africa, central Asia, Persia, and North and South America. The disease occurs in many areas which are liable to outbreaks of louse relapsing fever, but also in places where the latter disease is unknown. It has never been reported from some extensive regions in India and China where louse relapsing fever is common. On the whole it is much less important as a cause of sickness and death than louse relapsing fever. *Distribution*

Bacteriology

Sp. duttoni differs from *Sp. recurrentis* in (i) being readily inoculable into rats and other rodents without a preliminary passage through monkeys; (ii) being conveyed in natural conditions by ticks instead of by lice; experimentally successful transmission of the *Sp. duttoni* by lice has been recorded, but there is no clear evidence that this mode of transmission is of practical importance in natural conditions; (iii) causing different morbid manifestations in man; and (iv) having its chief reservoir in lower animals instead of man, though man may in some cases also serve as a reservoir of the organism.

Various species of *Ornithodorus* are the usual vectors, but other ticks have also been incriminated. Infected ticks have often been found in the walls of burrows of various rodents far from human habitations, *Vectors* and in camping-grounds, huts, and in the walls and floors of houses. There is abundant evidence that ticks often acquire infection from lower animals; indeed it may be that man is of secondary importance as a reservoir of infection: if this should prove to be true, the name 'epizootic relapsing fever' would be appropriate to distinguish the disease from epidemic relapsing fever. The offspring of infected ticks are often infected by transmission of the spirochaetes through the eggs.

Animal reservoirs of infection

Many kinds of rodents, especially rats and squirrels, have been found infected; dogs, jackals, porcupines, and pigs are occasional reservoirs of infection but are probably of minor importance. The extent to which man serves as a reservoir of infection remains an unsolved problem. The organism persists for long periods in the brain of infected rats.

Mode of infection

The tick may convey infection without being crushed, and the spirochaetes probably enter the body through the bite, the infected fluid extruded from the coxal gland of the tick being the chief medium by which infection is conveyed. Immediate removal of ticks and disinfection of the bites may therefore prevent infection.

Clinical picture

The disease period (i.e. the interval between the onset of one fever spell and the next) is shorter as a rule than in louse relapsing fever, being 8 to 12 days as a rule. The fever spells are also shorter, and the temperature tends to be higher (see Fig. 67, B). The average number of relapses is greater, being usually 4 to 6 instead of 1 to 2. Spirochaetes are less numerous in the blood. Facial paralysis, spastic paraplegia, iritis, diarrhoea, and dysentery are common complications. The mortality varies from 3 to 8 per cent, the disease being, on the whole, much less fatal than louse relapsing fever.

Mortality

Diagnosis

Diagnosis is on the same lines as in louse relapsing fever (see p. 590), but the spirochaetes may be so few as to necessitate a prolonged search. On the other hand, the temperature chart is usually very characteristic, though the fever spells may be of irregular occurrence. Animal inoculation is more likely to be helpful, for rats are usually susceptible.

Treatment

Avoidance of tick bite

Prevention consists in avoidance of tick bite in endemic areas, in destruction of ticks and rodents, and in the immediate removal of ticks from the body by the local application of a drop of kerosene or of turpentine. If the tick has to be removed forcibly, the site of the bite should be cauterized by a drop of pure liquefied phenol. Despite the absence of clear evidence that the organism is ordinarily transmitted from man to man by lice it is a wise precaution to de-louse the patients and contacts. Camping-grounds or houses which are suspected to harbour infected ticks should be avoided.

Treatment

The spirochaetes are rather resistant to arsenicals, so that the dose has to be large, e.g. 0·8 gram of novarsenobillon for an adult of 160 lb. weight, and proportionally larger or smaller doses for persons of greater or less weight. Katz recommended neoarsphenamine 0·3 gram on the first day of the attack, 0·45 gram three or four days later, and 0·6 gram after an interval of five or six days. This method of treatment appears to be eminently rational.

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RESUSCITATION

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Reference may also be made to the following titles:

ASPHYXIA
ASPHYXIA IN CHILDREN
BLOOD TRANSFUSION
DROWNING: RESUSCITATION
ELECTRICAL INJURY
GASSING AND POISON GASES IN WAR
SHOCK AND COLLAPSE
TOXICOLOGY

1.–DEFINITION

1363.] Resuscitation has been defined as the restoration of life or consciousness in one almost or apparently dead.

2.–INTRODUCTION

Application

Most modes of dying are the final manifestation of irreversible changes in the organism which render attempts at resuscitation futile. Such attempts with any hope of success can be made only in those cases in which death is imminent from failure in function of a vital system due to recoverable or remediable disease or to noxious agencies which can be removed. Deaths immediately due to failure of the respiratory mechanism make up most of this group. The remainder is composed of cases in which failure of a healthy or relatively healthy circulatory system is the immediate cause of death, either from the condition of vasomotor collapse known as shock or from sudden cardiac inhibition. In various types of reversible biochemical derangement dramatic restoration of the moribund to life can occasionally be effected. The most striking instance of this is the recovery of the patient in hypoglycaemic coma after glucose administration (see Vol. VII, p. 47); others occur in diabetic coma (see Vol. III, p. 666) and the crises of Addison's disease (see Vol. I, p. 242). Though these examples come within the formal definition of resuscitation, by convention this term seems to be confined to those cases in which attention must be directed to the cardiovascular and respiratory systems.

Respiratory failure

Failure of the respiratory mechanism includes failure due to environmental causes, as in drowning and in asphyxia; peripheral respiratory failure, as in the respiratory paralysis of diphtheria and in some of the cases of respiratory failure in acute poliomyelitis; failure of oxygen transport, as in poisoning by carbon monoxide and in severe anaemia; and central respiratory failure due to depression of or injury to the medullary centres, as in narcotic or anaesthetic poisoning. Central failure due to anoxaemia is also a factor in the later stages of cases belonging to any of the preceding categories.

The practical problem of resuscitation therefore is in nearly every instance the treatment of respiratory failure of one or more of these types; in many cases specific measures to combat the cause of the failure may also be possible; occasionally methods of restoring the cardiac action may be indicated; and in most cases general measures to combat shock are necessary.

Importance of time factor

After cessation of respiration from any of the above causes the heart-beat usually continues for a variable length of time, often several minutes. Even after it has ceased to beat, for as long as twenty minutes after apparent standstill, the heart may respond once again to suitable stimulation; but it has been shown both experimentally and by clinical experience that the limit of time after respiratory and cardiac standstill during which resuscitation is possible is set by the capability of the nerve-cells of the central nervous system to withstand deprivation of oxygen. Stewart *et al.*, from investigation of the effect of complete occlusion of the cerebral circulation in cats, found that recovery always

Time limit determined by cerebral anoxia occurred after occlusion for less than 7½ minutes, and that the maximal duration of occlusion after which recovery occurred was 16½ minutes. These figures are in general agreement with clinical experience, which suggests that the maximal period of cerebral anoxia which is compatible with recovery is about fifteen minutes. This figure is necessarily a tentative estimate, since the onset of dangerous cerebral anoxia does not necessarily coincide with either cessation of respiration or cessation of heart-beat. In a death from any form of asphyxia resuscitation is not likely to be possible after the lapse of more than eight minutes from cessation of the heart-beat. The tragic experience of restoring the heart-beat by suitable measures only to find that spontaneous respiration is never re-established or of restoring normal respiration also only to find that the patient never recovers from coma due to damage to the higher cerebral centres during the prolonged anoxaemia is by no means uncommon. The need for speed and resolution in attempts at resuscitation is obvious.

Maximal period of cerebral anoxia compatible with recovery

3.–METHODS OF RESUSCITATION

(1)—General

(a) *Artificial Respiration*

Manual and 'rocking' methods

For the manual methods for first-aid use and the 'rocking' methods, which require simple apparatus, see Vol. IV, p. 238. Efficiently performed these are adequate to maintain the respiratory function when natural respiration has ceased, and prompt application of such methods is the foundation of successful resuscitation in nearly every instance. The mechanical methods described below were first developed to deal with the rather special problem of maintaining respiration over long periods in paralysis of the respiratory muscles. These special apparatus are not likely to be available for more urgent emergencies. If they are, they can be used in any case in which artificial respiration is indicated; but knowledge of their availability should not delay the institution of manual methods.

Mechanical methods

Drinker respirator

Drinker and Shaw were responsible for the development of this apparatus (see Fig. 68). It has two essential parts: (i) an air-tight steel chamber in which the patient is enclosed up to the neck and (ii) an electrically driven air-pump with which rhythmic changes in the pressure in the box can be made. The patient lies on a mattress placed on a truck, to which is attached the lid of the chamber. The truck can be pulled in and out without difficulty so as to permit examination of the patient. The head and neck extend out of the end of the chamber through a rubber collar, which fits closely enough to withstand the pressure variations in the chamber without causing discomfort or obstructing the circulation. The pressure inside the chamber is alternately reduced and restored to normal. When the pressure is reduced, the patient's chest is expanded and air drawn in as in normal inspiration; on restoration of the pressure to atmospheric, the chest returns to its expiratory position by elastic recoil.

Alternations of pressure

Alternating reduction of the pressure below atmospheric and increase above atmospheric were tried at first, but the phase of increased pressure was relatively ineffective. An alternation of a pressure of 12 to 18 centimetres of water below atmospheric and of atmospheric pressure effects a satisfactory respiratory ventilation in most patients. The pressure variations are registered on a water manometer attached to the chamber. By varying the pressures and the rate of alternation a very wide range of control of the depth and rate of respiration can be obtained.

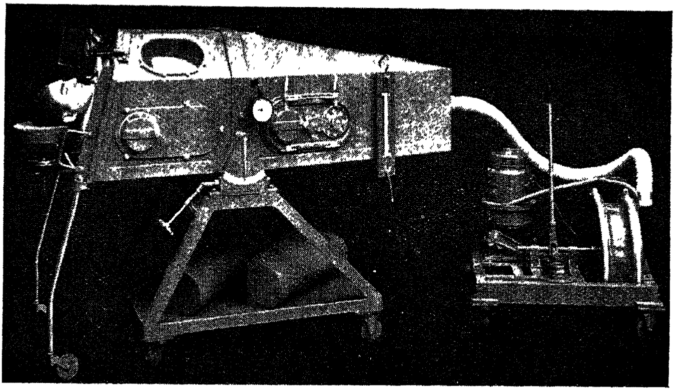

FIG. 68.—The Drinker respirator

The apparatus can be tilted in either direction to effect postural change, which is often important. Hand-holes are provided in the side of the machine for medical and nursing care of patients who cannot be removed even for a short time. Tubular extensions can be attached to the sides of the chamber to accommodate patients in whom splinting of the arms is desirable. A special small size has been made for use in asphyxia neonatorum.

The Drinker respirator undoubtedly provides a closer approach to physiological respiration than any other method of artificial respiration. It is a large and expensive piece of apparatus, the general availability of which is necessarily limited.

Bragg-Paul respirator

This apparatus (see Fig. 69) is simpler in construction and working than the Drinker respirator. The principle was first suggested by Sir William Bragg and the mechanism developed by Mr. R. W. Paul for use in a case of progressive muscular atrophy, in which the apparatus maintained artificial respiration almost continuously for three and a half years; in spite of almost complete muscular paralysis, intellectual activity was retained to the end (Kerridge).

The pulsator is designed to cause regular alternate inflation with air and emptying of a stout rectangular rubber bag, resembling on a large scale a sphygmomanometer cuff. The bag is secured round the lower thorax by straps fastened by an ingenious chain-clip. The effect is a steadily increasing pressure on the thorax and upper abdomen, causing expiration, followed by sudden release, leading to inspiration by the elastic recoil of the chest wall.

Mechanism

The pulsator mechanism consists of bellows rhythmically compressed and relaxed by a plate moved by an electric motor. In the latest models this works with a commendable absence of noise even after prolonged use. There is also provision for manual working, should an electrical break-down occur. The original model was worked by hydraulic power, from the ordinary water-supply. The rate of the compression cycle can be varied within reasonable limits, and the pressure to which the belt is inflated is under control and registered by an easily visible gauge. Pressures varying from 0 to 25 mm. Hg in children and up to 35 mm. Hg in adults have proved satisfactory.

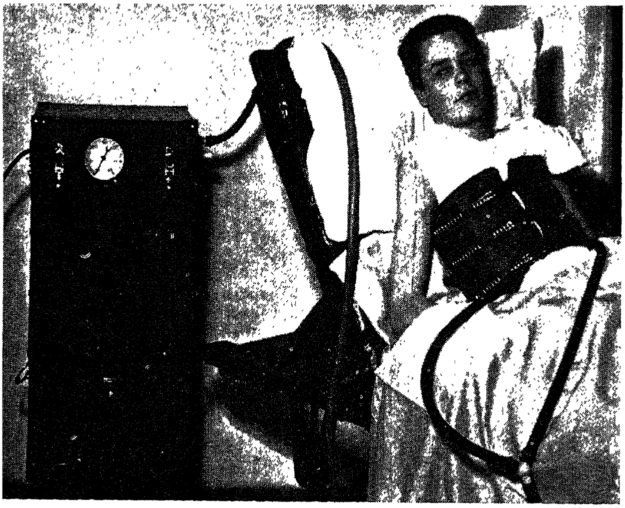

FIG. 69.—The Bragg-Paul pulsator (by courtesy of Mr. R. W. Paul)

Comparison with Drinker respirator

From the point of view of the mechanics of respiration, the Bragg-Paul pulsator cannot be as efficient as the Drinker respirator. Inspiration is the active part of the normal respiratory cycle, whereas expiration is passive; this sequence can be imitated in the Drinker respirator, whereas the pulsator works by active expiratory pressure followed by passive inspiration. The range of control of pulmonary ventilation which can be effected is much greater with the Drinker apparatus. Nevertheless clinical trial has shown that the Bragg-Paul pulsator is efficient in maintaining prolonged artificial respiration in such conditions as respiratory paralysis following diphtheria and in poliomyelitis. There are reports of its successful use in the emergencies of collapse during operations. The pulsator has many practical advantages: it is less costly and much more portable. It has been shown to be possible to actuate two chest-belts of the child size from one pulsator mechanism, still further reducing the effective cost in an institution such as a fever hospital, where there may be a demand for more than one such apparatus. Its use does not interfere in any way with routine medical or nursing care. This is specially valuable in emergencies, for example, when a patient is brought into hospital in coma of obscure origin with respiratory failure the pulsator can be put into operation without delay and without interference with the investigation of the cause of the coma. Another important asset of the pulsator is that its use is attended by very little psychological upset, so that extra sedatives are not required when it is being used on conscious patients.

Oxygen administration

It is obviously logical to administer oxygen to any patient who is in need of artificial respiration and in whom cyanosis continues in spite of this measure. In such cases, apart from those of paralysis of the respiratory muscles, the use of carbon dioxide as well as oxygen is indicated. The methods of administration are outlined below, and similar methods can be used for oxygen administration alone in cases of peripheral respiratory paralysis.

(*b*) *Stimulation of Respiratory Centre*

Carbon dioxide

The predominant part played by carbon dioxide in the regulation of respiration in the normal subject was made clear at the beginning of the century by the researches of Haldane and others (see Haldane and Priestley), and it was shown that excess of this gas in the inspired air was a potent stimulus to respiration, concentrations of 5 to 6 per cent being capable of causing a four- to five-fold increase in the pulmonary ventilation. Carbon dioxide probably exerts this action not only through the medullary centres but also through the carotid sinus; for the purpose of the present discussion the exact mechanism of stimulation is of minor importance. Application of this knowledge to problems of resuscitation was delayed by the idea that in asphyxia excess of carbon dioxide must already be present, especially as it was established that moderate anoxaemia lowered the threshold of stimulation of respiration by carbon dioxide. On the other hand, it was found that in asphyxia due to interference with the transport of oxygen, as in carbon monoxide poisoning, the carbon dioxide of the blood was reduced during an initial phase of hyperpnoea, and that thereafter the breathing became shallow and could advantageously be stimulated by increasing the proportion of carbon dioxide in the inspired air. The success of this measure led to the trial of carbon dioxide therapy in other forms of asphyxia, and experience has shown that, even when asphyxia is due to interference with the mechanics of respiration, so that it is probable that excess of carbon dioxide is already present, inhalation of this gas is the most efficacious stimulus to respiration. It has been suggested by Yandell Henderson, who has particularly emphasized the value of carbon dioxide therapy, that this apparent contradiction is explicable by a marked diminution in the sensitivity of the respiratory centre during the later stages of anoxaemia.

Low concentrations

There is no evidence of any danger from the inhalation of gas-mixtures containing up to 7 per cent of carbon dioxide. It is therefore a reasonable measure to administer this gas in this concentration in any case of respiratory failure, apart from those due to muscular paralysis, in which artificial respiration is necessary. In addition to increasing the physiological stimulus to respiration it guards against the danger of excessive washing out of carbon dioxide, which would lead to apnoea even if the respiratory centre recovered its normal sensitivity after relief of anoxaemia.

High concentrations

There is evidence that prolonged inhalation of high concentrations (30 per cent or more) has a narcotic effect, causes clonic convulsions, and depresses the respiratory and cardiac functions (Leake and Waters). In certain circumstances, however, as in asphyxia neonatorum and possibly in resuscitation from drowning, the use of concentrations of carbon dioxide of 20 to 30 per cent for a short time only has been recommended, followed by more prolonged inhalation of a lower percentage.

Methods of administration

Sparklet

Novox resuscitator

Gas-bag, mask, and cylinder

Campbell box-mask

Carbon dioxide can be administered without oxygen, mixed with air, by such simple means as the 'Sparklet' apparatus, specially designed for immediate availability (see Vol. IV, Fig. 55, p. 236). In every case in which it is needed oxygen is also helpful; the gases may be given together by special apparatus, such as the 'Novox resuscitator' (see Vol. IV, Fig. 54, p. 235). The most convenient method of administration requiring no specially designed apparatus is, by means of an ordinary anaesthetic gas-bag and mask, from a cylinder containing a mixture of carbon dioxide and oxygen. The proportion of carbon dioxide should be 7 per cent; lower percentages are often ineffective. Administration by the Campbell box-mask or by a double nasal catheter, as used for oxygen therapy, is also efficient; but with these devices considerable dilution with air occurs, and higher percentages of carbon dioxide are required to ensure 7 per cent in the inspired air. With the nasal catheter 20 per cent and with the box-mask probably 10 per cent is necessary, with a flow of 5 litres or more per minute.

Drugs stimulating respiratory centre

The fact that certain drugs, such as strychnine, lobeline, caffeine, and synthetic products such as coramine, stimulate the medulla, shown by

Comparison with carbon dioxide

Use in narcotic poisoning

increased depth of respiration in the experimental animal, has led to the wide-spread use of such drugs as an adjunct to other methods of treatment of respiratory failure; but, compared with that of carbon dioxide, their action in stimulating respiration in the normal subject is feeble. and there is no evidence that their action on the anoxic respiratory centre of asphyxial states is relatively any stronger. In these cases the indications are to relieve the anoxaemia by the methods set forth above, when the respiratory centre, if capable of responding at all, will respond best to its normal stimulus, carbon dioxide. The one possible sphere of usefulness of these drugs is in poisoning by narcotics, such as the barbiturates, overdoses of anaesthetics, and opium. Their action in these cases may be to some extent that of pharmacological antidotes, and they should be used in full doses; for instance, strychnine hydrochloride $\frac{1}{12}$ to $\frac{1}{8}$ grain subcutaneously or coramine (25 per cent solution of pyridine-β-carboxylic acid diethylamide) 10 c.c. intravenously for an adult suffering from narcotic poisoning.

(*c*) *Cardiac Resuscitation*

Limits of applicability

Occasionally life has been restored even after the heart has ceased to beat. The possibility of such restoration is confined to asphyxial death in which the cause of the asphyxia has been removed and to sudden cessation of the heart-beat, usually attributed to vagal inhibition, such as may occur during anaesthesia, especially light chloroform anaesthesia, or, rarely, in patients with Stokes-Adams syndrome. The limit of time within which resuscitation is possible in such circumstances has been indicated on page 598.

Cardiac massage

Mechanical stimulation of the heart or 'cardiac massage' is a method which has naturally been used most in the treatment of cardiac standstill during anaesthesia. Through an upper abdominal incision the heart is slowly and rhythmically compressed; this may be possible in children through the intact diaphragm, but in most instances it has been necessary to make an incision in the diaphragm and to grasp the heart. If this is done, the danger of pneumothorax must be guarded against. Whether or not the successes recorded by this method are due to mechanical production of a circulation is doubtful. It is certain that very considerable force must be used to produce a circulation by manual compression of the heart; probably stimulation of the heart to renewal of spontaneous contractions is the more important factor. Such stimulation can be more rapidly applied by the simpler methods of cardiac puncture, which appear preferable as a first measure in all cases except during operations in which the incision of approach has already been made.

Cardiac puncture

Cardiac puncture was first used for direct intracardiac injection of various drugs. The successful restoration of the heart-beat does not depend on the particular drug used; it seems rather to be due to the production of a fresh irritable focus in the myocardium at the seat of puncture. The first induced beats are extrasystoles, and in asphyxial

Ventricular

Auricular

cases it is presumably only when the re-established circulation has relieved tissue anoxia that the sino-auricular node recovers and takes over its normal part of pace-maker. Puncture is most easily performed in the region of the right ventricle; a needle 6 cm. long, introduced through the fourth left intercostal space close to the sternum, will enter this part of the heart. Auricular puncture is preferable, because it is better that the first ectopic impulses should come in the normal fashion from the auricles to the ventricles; because there is some risk of ventricular fibrillation after ventricular puncture; and because the auricles are more sensitive to mechanical stimulation (Hyman, 1930).

The technique of auricular puncture is rather more difficult than that of ventricular puncture. It requires the use of a long slightly curved needle, which should be introduced through the third right intercostal space close to the sternum downwards and towards the middle line; it will pierce the right auricle at a depth varying from $4\frac{1}{2}$ inches in large adults to 2 inches in children (Hyman, 1930).

Drugs used

The drugs that have been used for intracardiac injection include adrenaline, ether, caffeine, strychnine, digitalis, dextrose, camphor, coramine, and cardiazol. There is no reason for attributing a beneficial action to any of these, with the possible exception of adrenaline; and, even with this, injection into the myocardium may cause serious damage to the muscle. It therefore seems best in attempting cardiac resuscitation to perform auricular puncture if a suitable needle is available or, if not, ventricular puncture and, if no response follows, to inject 1 c.c. of 1 in 1,000 solution of adrenaline hydrochloride into the cavity of the heart.

Hyman's 'artificial pace-maker'

Hyman (1932) described an 'artificial pace-maker'. The heart is punctured by a special needle constructed so that its tip forms two electrodes, to which are rhythmically applied electrical impulses from a magneto driven by a spring motor. This ingenious apparatus has not yet been used extensively enough for its value to be assessed.

(*d*) *Relief of Shock*

Maintenance of body-temperature

Drugs

This is discussed at length under the title Shock and Collapse. A point of great importance, which is frequently neglected in attempts at emergency resuscitation, is the necessity of maintaining the body-temperature either by simple means, such as blankets and hot-water bottles, or by a hot-air cradle. The only drugs which are likely to combat the fall of blood-pressure, which is the most alarming feature of acute shock, are adrenaline, which has a transient powerful action, and ephedrine, which has a more prolonged effect. These should be given intramuscularly; appropriate doses are 1 c.c. of 1 in 1,000 solution of adrenaline hydrochloride and $\frac{1}{2}$ grain of ephedrine hydrochloride. There is no evidence that so-called 'analeptics', such as strychnine, camphor, coramine, and cardiazol, are of the slightest value in the treatment of shock.

Blood transfusion

The extreme value of blood transfusion in cases in which loss of blood is a factor is not likely to be forgotten. It is less widely realized that an anaemic patient may be desperately anoxaemic, so that he will benefit by administration of oxygen, and yet not show any cyanosis, owing to lack of sufficient haemoglobin. If a patient remains comatose and unable to take fluids by mouth for a prolonged period after resuscitation from an acute emergency, the administration of physiological saline with 5 per cent glucose either by rectum or preferably by a slow intravenous drip method is necessary to prevent dehydration.

Injections of saline and glucose

(2)—Specific

In Asphyxia

See Vol. II, p. 168.

In Asphyxia in Children

See Vol. II, p. 175.

In Drowning

See Vol. IV, p. 235.

In Electric Shock

See Vol. IV, p. 481.

(*a*) *In Respiratory Paralysis*

The commonest forms of respiratory paralysis due to recoverable conditions are those due to diphtheria and to poliomyelitis. It is in these conditions that the mechanical methods of artificial respiration are most needed.

Diphtheria

Reference has been made on page 601 to the successful use of the Bragg-Paul pulsator in the treatment of respiratory paralysis in diphtheria. McSweeney (1938) reported 33 cases treated thus, with 25 recoveries.

Poliomyelitis

Experience in the treatment of the respiratory paralysis of acute poliomyelitis with the Drinker respirator has been most extensive in the United States. Brahdy and Lenarsky recorded their experiences with 63 such cases treated in the respirator, out of a total of 1,632 cases of poliomyelitis admitted to the Willard Parker Hospital, New York, in two years. The type of case in which respiratory paralysis was of central origin, being part of a general bulbar involvement, received no benefit from treatment in the respirator, cases of diaphragmatic and intercostal paralysis due to spinal lesions being those in which the treatment might be successful. The risk of aspiration of secretions was great; careful removal of pharyngeal secretions was necessary, and a posture with the head down was advisable. Sedatives were often necessary to allay apprehension on first placing a child into the apparatus. The authors did not recommend the use of the respirator unless there was a real indication in the form of cyanosis, because they concluded that pulmonary infections due to aspiration were more frequent after its use in spite of precautions. Of the 63 patients 12 were of the bulbar type and died; of the 51 'spinal' patients 24 died in hospital. The average

Suitable types of case

duration of treatment of recovered cases in the respirator was 13 days. Of the 27 survivors 13 had died at the end of a 4½ years' follow-up, all but one of a pulmonary condition. Of the 14 who were still alive 2 had no residual paralysis, 5 were able to live normal lives but with some residual paralysis, and the remaining 7 were more or less completely incapacitated.

Progressive muscular atrophy

Myasthenia gravis

The successful treatment of respiratory paralysis supervening in a case of progressive muscular atrophy by the Bragg-Paul pulsator has been mentioned on page 599. In myasthenia gravis the effect of prostigmin may be so dramatic as to be called resuscitation.

(*b*) *In Carbon Monoxide Poisoning*

Cause of death

Carbon monoxide causes death by forming a compound with haemoglobin which is much more stable than oxyhaemoglobin, its affinity for haemoglobin being approximately 300 times that of oxygen. The prolonged inhalation of 0·047 per cent of carbon monoxide causes the combination of 50 per cent of the haemoglobin of the blood with carbon monoxide. A saturation of 60 to 80 per cent is sufficient to cause death (Haldane).

Treatment

In this condition the inhalation of oxygen 93 per cent and carbon dioxide 7 per cent is indicated. The high oxygen concentration hastens the removal of carbon monoxide, and the carbon dioxide stimulates respiration and guards against the dangers of deficiency of carbon dioxide or acapnia (Henderson). If respiration is shallow or has ceased, artificial respiration will be required. There is no convincing evidence that injection of methylene blue, which has been recommended, is of benefit. The essential part of the treatment is that elimination of carbon monoxide should be expedited by the measures indicated above as soon as possible after removal from the poisonous atmosphere (see also TOXICOLOGY).

(*c*) *In Narcotic Poisoning*

Treatment

This includes poisoning by opium and its derivatives and by hypnotic drugs, such as barbiturates, chloral hydrate, and paraldehyde. The practical points in the treatment, which can be applied to any case of poisoning with coma, are artificial respiration, if necessary, and the inhalation of oxygen and carbon dioxide; if the poison was taken by mouth, adequate gastric lavage, with the patient in a head-down posture to minimize the danger of aspiration; and the administration of large doses of strychnine and coramine (see p. 603), which in these cases act to some extent as pharmacological antidotes by stimulation not only of the respiratory centre but also of the higher centres. Lumbar puncture should also be performed both to reduce the cerebrospinal fluid pressure, which is generally raised, and to aid in elimination of the poison from the central nervous system. In prolonged coma treatment directed against dehydration will be required.

(*d*) *In Emergencies during Anaesthesia*

The main types of emergency that may occur during well conducted anaesthesia are primary cardiac failure and a more gradual deterioration which is probably allied to shock. Accidents which may occur from errors of technique are asphyxia and overdosage.

In addition to the measures described above, the anaesthetist often has at his disposal an alternative method of artificial respiration; with any of the commonly used gas and oxygen machines the lungs can be slowly and rhythmically inflated with oxygen, preferably with the addition of up to 10 per cent of carbon dioxide. This procedure is best carried out through a wide endotracheal tube of the Magill type.

Primary cardiac failure

Primary cardiac failure most often occurs with light anaesthesia, usually with chloroform. In children the condition described as status lymphaticus, characterized by enlargement of the thymus and hyperplasia of lymphoid tissue, about which there is still much controversy, is often alleged to increase the liability to this accident (see also THYMUS GLAND DISEASES). A sudden stimulus under light chloroform anaesthesia and the introduction of adrenaline into veins are also possible causal factors. The accident is attended by sudden pallor, dilatation of the pupils, and cessation of pulse and respiration. Treatment consists of placing the patient in the Trendelenburg position, institution of artificial respiration with oxygen and carbon dioxide mixture, and, if there is no evidence of return of the pulse within two minutes, methods of cardiac resuscitation described on page 603.

Signs

Treatment

Shock

The more gradual deterioration in the patient's condition which may be observed later during operations is probably due to several factors. The chief of these are loss of fluids, including both blood loss and loss of water in sweating and by way of the respiratory tract; trauma, which may act both by liberation of a histamine-like substance from the damaged tissues and by reflexes through sensory nerves; loss of heat; prolonged anaesthesia; and oxygen deficiency.

Signs

This condition of 'shock' is manifested by the gradual onset of pallor, sweating, coldness of the skin, a rising pulse-rate and falling blood-pressure, diminished depth or irregularity of respiration, and dilating pupils. The amount of the anaesthetic agent required to maintain anaesthesia is much diminished.

Prophylax

Such prophylactic measures as are possible can be deduced from the predisposing causes. They include the avoidance of pre-operative dehydration by adequate fluid intake by mouth or otherwise; the abolition of harmful sensory stimuli either by adequate depth of general anaesthesia or by the addition of suitable local or regional anaesthesia; the adequate warming of the operating theatre and avoidance of unnecessary exposure both of the patient and of his viscera; the maintenance of a clear airway and of efficient oxygenation; and the avoidance of unnecessary prolongation of duration of the operation. There is some evidence that chloroform and, to a less extent, ether predispose to shock; these agents should therefore be avoided in patients who are already in a state of shock.

Symptomatic treatment

Treatment consists in lowering the head, ensuring a clear airway, increasing the oxygen precentage of the inspired mixture if there is still cyanosis, and adding 5 to 10 per cent of carbon dioxide. Fluid should be administered in the form of physiological saline with 5 per cent glucose either by the rectum or by slow intravenous infusion. Blood transfusion may be of the greatest value in shocked patients, even if loss of blood does not appear to have been excessive. To combat an excessive fall of blood-pressure either ephedrine hydrochloride ½ to 1 grain or, for more urgent use, adrenaline hydrochloride solution 1 in 1,000, 0·5 to 1 c.c. should be injected intramuscularly or may be added to a slow intravenous saline infusion. Pituitary (posterior lobe) extract has also been used but does not appear to have any advantage over adrenaline. Camphor, coramine, and strychnine are of doubtful value in these emergencies.

Overdose of anaesthetic

The treatment of overdosage of an anaesthetic agent, which may be either one of the inhalational anaesthetics or, more commonly, one of the basal narcotics, such as nembutal, evipan sodium, avertin, or paraldehyde, is the same as that for poisoning by any other narcotic. Coramine is specially useful as an antidote to basal narcotics of the barbiturate group, and ephedrine has a useful antagonistic effect to avertin.

Asphyxia

Asphyxia may arise during anaesthesia as the result of obstruction to the airway or as the result of inhalation of a mixture containing too little oxygen. It is shown first by cyanosis and finally by cessation of respiration. The treatment consists in the detection and correction of the cause and, if the respiratory function is not restored, the institution of artificial respiration and inhalation of oxygen and carbon dioxide mixture. Should secondary cardiac standstill occur as the result either of overdose or of asphyxia, cardiac puncture or massage should be performed.

(*e*) *In Emergencies in Cardiovascular and Pulmonary Diseases*

The subject of acute pulmonary oedema is considered elsewhere (see Vol. VIII, p. 169) and the treatment, by morphine, venesection, Poulton's plus-pressure machine, and the pressure chamber, is fully described.

When acute pulmonary oedema arises as the result of inhalation of noxious gases, similar principles of treatment apply. Absolute rest and oxygen inhalations without carbon dioxide are indicated (see Vol. V, p. 521).

Stokes-Adams syndrome

Death often occurs in patients with Stokes-Adams attacks, which are due to temporary ventricular standstill, merely from failure of the ventricles to start beating again. If the patient is seen in time, the ventricles can be started again by ventricular puncture and injection of 0·5 c.c. of a 1 in 1,000 solution of adrenaline hydrochloride. For the general treatment of this condition see Vol. II, p. 29.

Pulmonary embolism

Although pulmonary embolism is common in the course of various diseases, it makes its most tragic appearance as a post-operative and puerperal complication. Though the method cannot be of wide application, the operation proposed by Trendelenburg for operative removal of the embolus from the pulmonary artery must be mentioned. Several patients have been restored to life by this desperate remedy (Nyström).

Spontaneous pneumothorax

In some cases of spontaneous pneumothorax of valvular type the picture may be one of asphyxia, and a patient *in extremis* can be restored to comfort by the simple measure of letting the air out of the pleural sac. (See Vol. IX, p. 749).

Accidents during needling of the pleura

When the pleura is needled, whether for aspiration or for induction of pneumothorax, several forms of collapse may occur. The least serious and commonest is a simple fainting attack, evidenced by pallor, a feeling of faintness, and slowing of the pulse. The only treatment required is to put the head low (see also Vol. II, p. 644). The more serious accidents are pleural shock and air embolism. Pleural shock, which is very rare, seems to be very similar to, and as serious as, primary cardiac failure under anaesthetics and should be treated on the same lines. Air embolism presents as a sudden collapse followed by neurological symptoms—amaurosis and various paralyses due to cerebral embolism are common—which are often transient. The differentiation between pleural shock and air embolism is often impossible at the time of the acute collapse and can generally be made only when evidence of cerebral embolism is found. Ophthalmoscopy has occasionally given a clue to the diagnosis by showing air-bubbles in the retinal vessels.

Pleural shock

Air embolism

Caisson disease

Another condition in which collapse is due to the presence of gas-bubbles in the blood-stream is caisson disease. In severe cases recompression is the only effective measure of resuscitation (see Vol. II, p. 734).

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RETICULO-ENDOTHELIAL SYSTEM DISEASES

See SPLEEN DISEASES

RETINA DISEASES

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Reference may also be made to the following titles:

BLINDNESS
CEREBRO-RETINAL SYNDROMES
EPILOIA
EYE EXAMINATION
EYE, HEREDITARY DISEASES
LINDAU'S DISEASE
NEPHRITIS AND NEPHROSIS
NEUROFIBROMATOSIS
PAPILLOEDEMA
PITUITARY GLAND DISEASES

1.—AETIOLOGY

Retinal diseases

1364.] Retinal diseases are relatively few, often of very obscure causation, and in most cases very little amenable to any form of treatment. The retina, however, is often the site of lesions associated with general diseases, and in some cases the retinal picture may decide the diagnosis or give valuable aid towards the assessment of progress and prognosis. Gross impairment of vision may arise from these lesions, but neither local nor general treatment helps much to check or repair the damage.

Retinal manifestations of general diseases

The retina is very closely related to the choroid; the nutrition for the outer layers of retinal cells and fibres comes from the choroidal circulation; therefore alterations in the lamina choriocapillaris readily affect the retina adjacent to it, i.e. the percipient layer of rods and cones.

Anatomical relation to choroid

The pigmented layer of the retina often seems to behave more as a part of the choroid than of the retina, and lesions adjacent to it in retina or choroid very readily produce proliferation and migration of pigment forwards into the inner layer of the retina. These facts explain the fundus picture of many retinal diseases and why all choroidal conditions affect the retina secondarily. The converse of this, however, does not hold good, because in most primary retinal states the choroid is unaffected.

2.–CONGENITAL DEFECTS

(1)—Coloboma

1365.] Coloboma of choroid and retina is due to faulty closure of the foetal ocular cleft. The dome-shaped coloboma in the lower part of the fundus is a gleaming white; it may be small or reach so far back as to involve the optic disc. (For coloured plate see Vol. II, Plate III, A, facing p. 422.) The colobomatous area is fringed with pigment and may be traversed by a few blood-vessels from the retina or from the choroid. The eye is usually amblyopic according to the extent of the coloboma and often shows defects in other parts of its structure, e.g. coloboma of the iris.

A central area resembling the typical inferior coloboma is sometimes seen. Most of these cases are probably choroido-retinal atrophy following inflammation at some early period, but the frequency with which the condition is bilateral and the recorded familial incidence suggest a developmental origin in at least some instances.

'Coloboma' of the macula

(2)—Opaque Nerve-Fibres

Medullated or opaque nerve-fibres in the retina are seen as a white striated tuft most commonly continuous with the disc. The retinal vessels are in places hidden in the white area, which has a feathery edge. This and the fine striation distinguish this condition from a patch of exudation, and the absence of disturbance of pigment differentiates it from the scar of an old patch of inflammation.

(3)—Septum

This is seen as a fold of the inner layers of the retina stretching from the optic disc out into the periphery, usually in the lower temporal quadrant.

(4)—Pigment Anomalies

Various forms are seen, the commonest being aggregations of flat polygonal plaques of pigment, several tending to lie together, resembling the dirty paw marks of an animal. They are congenital in origin and do not undergo change. Their recognition, however, is important, lest they be mistaken for some condition of greater importance, such as pigmented sarcoma of the choroid.

3.–INJURIES

(1)—Commotio Retinae

See Vol. II, p. 417.

(2)—Haemorrhages

1366.] Haemorrhages of almost any kind, but usually superficial, may be produced by trauma. Only in the case of a deep central haemorrhage will visual acuity be permanently affected, but rest and a guarded prognosis are always necessary. (See below.)

(3)—Detachment

See separate section on Detachment of the Retina on page 632.

(4)—Photoretinitis

Trauma of the central area of the retina may be caused by exposure to bright light and is probably a burn from the infra-red rays. It may occur in unprotected eyes watching an eclipse of the sun or from the short-circuit flash of a powerful electric current.

Treatment In milder examples no visible changes are present, but central vision is temporarily lowered, whereas in more severe cases a mottled pigmented area shows in the macular region, and many of these patients suffer permanent loss of vision. Dark glasses and rest to the eyes are advisable.

4.–VASCULAR DISEASES

(1)—Haemorrhages

1367.] Haemorrhages of various types occur at any time of life from so many causes that the term 'haemorrhagic retinitis' means little.

Pre-retinal Pre-retinal (sub-hyaloid) haemorrhages tend to be large and bright red, with a flattened upper border and, from gravity, a convex lower edge (see Fig. 70). Many arise apparently spontaneously. They are fully absorbed, not damaging function in any way.

Superficial Superficial haemorrhages, in the nerve-fibre layer, are typically flame-shaped. They accompany toxic or obstructive states in particular and are absorbed slowly, leaving as a rule no traces nor affecting vision.

Circular Circular, punctate, or rosette-shaped haemorrhages lie deeper in the retina and are typical of lower-grade toxic states. They remain unchanged over long periods and may leave a small spot of permanent opacity.

Deep

Deep retinal or sub-retinal haemorrhages are large brownish circular or cloud-like areas seen most commonly in the central region, particularly in degenerative states. They almost invariably become organized into a plaque of tissue which permanently affects central vision.

Retinal haemorrhages in the new-born

Incidence

Haemorrhages are seen in the retina in 10 to 15 per cent of all new-born infants. The incidence figure varies partly on account of the time of examination and partly with the degree of assiduity with which the search is made in any particular case.

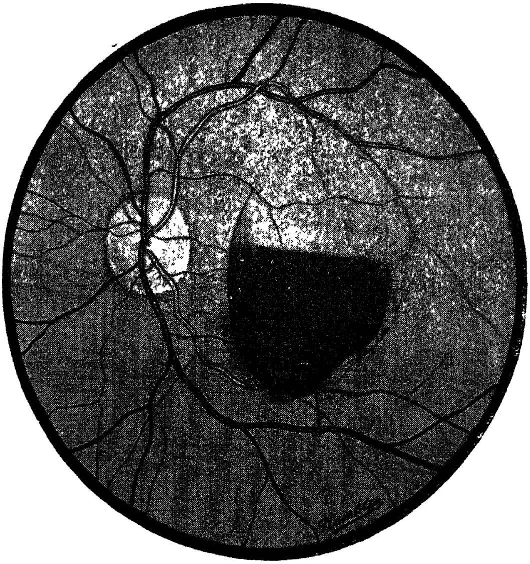

FIG. 70.—Pre-retinal (sub-hyaloid) haemorrhage

Relation to birth traum

The duration or severity of the labour does not bear any relation to the incidence of haemorrhage, but the absence of haemorrhages in the cases of Caesarean section that have been examined suggests that, in the process of birth, changes of intracranial pressure account for the retinal bleeding.

Persistence

The haemorrhages are most commonly flame-shaped, a type that is absorbed in a few days. Deeper haemorrhages take longer to disappear, and pre-retinal haemorrhages persist longest of all. Macular haemorrhages sometimes occur, and, although every haemorrhage clears in time, the possible damage done by a central haemorrhage may be remembered in connexion with those cases of amblyopia which are seen in later life and in which no gross lesion is discoverable to account for them, and no obvious cause can be found.

Relation to amblyopia

Recurrent vitreous haemorrhage (*Eales's disease*)

Definition This is an obscure condition in which spontaneous haemorrhages take place from the retinal vessels, in most cases bursting into the vitreous.

Incidence The large majority of subjects are boys and young men, but young women are sometimes affected. Both eyes are usually involved, although the lesion of one eye may be confined to small retinal haemorrhages which have not yet given rise to symptoms.

Causation The causation has always been regarded as most obscure and uncertain. The condition seems to be a definite retinal periphlebitis, and in some countries it is fully accepted as tuberculous. This is based on histological evidence, because there is no evidence of tuberculosis elsewhere in the patient. The argument, however, is not universally accepted, a fact in keeping with the division of opinion on ocular tuberculosis in general.

Onset The vision of one eye is suddenly obscured, the degree varying with the extent of the blood in the vitreous. The other eye may not show anything amiss or perhaps a little flecking of haemorrhage in some part of the peripheral retina. Occasionally a severe case shows, in the second eye, grosser but still localized haemorrhages with small whitish clouds of exudate on the retinal veins, which tend to lose their smooth contour and look 'craggy' and turgid. These signs herald a burst of blood into the vitreous.

Course The striking features of the course of the disease are (i) the rapidity of the clearance of the haemorrhage, unless it has been so gross as to disorganize the interior of the eye, and (ii) the formation of strands and sheets of fibrous tissue on the retina and in the vitreous as a sequel to the haemorrhages. These latter cause progressive deterioration of the eye if bleeding is often repeated. If the haemorrhages cease, very good vision may be retained.

Treatment The condition often appears to be self-limiting, and no form of treatment offers certain success in checking the bleeding. Rest in bed is probably of no value, and the best results are recorded from a long course of tuberculin injections. (See also Vol. II, p. 440.)

(2)—Arterial Disease

Value of examination of retina Examination of the retina is extremely valuable in arterial disease, because the well defined arterial system of the retina can be closely viewed under considerable magnification. The retinal arteries, like the cerebral vessels, form a terminal system, and the ophthalmoscope makes it possible to study an artery down to its smallest branches. As a result the different forms of arterial disease, present elsewhere in the body, may often be seen and assessed by the ophthalmoscope. Further, valuable clues about the state of the cerebral vessels may be obtained from the appearance in the retinal arterial system. In view of the patchy distribution of arterial disease, however, absolute proof cannot be expected from either positive or negative retinal evidence. Many persons have their fundi oculi examined when obtaining spectacles for presbyopia, and early arterial changes may be found by efficient observation. As this may be the first evidence of vascular disease in a person supposedly in normal health, the value of the examination can well be understood.

(*a*) *Arteriosclerosis*

The long-established signs of retinal arteriosclerosis are best seen in the middle-sized arteries, especially where they cross veins. The thickened artery alters the vein either by compression, 'nipping the venous blood column', or by pushing it out of its normal course (see Vol. V, p. 225, Fig. 30).

'Copper wire' artery

Hyaline changes in the middle coats of the artery produce a heightened light reflex from the surface of the vessel, the 'copper wire' artery; but care must be taken in evaluating this sign, because the normal light reflex varies within considerable limits. A broken or 'beaded' light reflex has a much more definitely pathological significance.

Tortuosity

Abnormal tortuosity of the larger vessels alone is not of any value, but considerable tortuosity of the small vessels approaching the macular region is a valuable sign of sclerosis of the smaller vessels of the system—often early evidence of wide-spread arterial disease.

Narrowing

Narrowing of the whole system or of parts of the system, leading to irregularity of calibre, is a valuable sign of an arterial lesion involving the endothelium rather than the outer layers of the vessel wall.

Haemorrhages

Retinal haemorrhages, usually flame-shaped, are often seen in the picture of a severe arteriosclerosis tending to lead to obstruction of the veins and the phase of exudates—the so-called arteriosclerotic retinitis.

'Silver wire' artery

The endarteritic form leads more commonly to the picture of 'silver wire' and obliterated arteries with consequent sector defects in the visual field and optic atrophy. (See also Vol. II, p. 439.)

(*b*) *Spasm*

Spasm of arteries has been suggested as the cause of certain visual symptoms and retinal changes, just as it has been invoked to explain some cerebral lesions. Transitory spasm, often freely recurrent, of the central retinal artery, or a branch, and passing without visible after-effects, is well established and is described in subjects not demonstrably the victims of either local or generalized arterial disease. Patients often describe 'blacking out' of the vision of both eyes for short periods. It is not likely that local arterial changes cause such attacks, but the temporary losses of vision of one eye in a person the subject of arterial disease may well be caused by spasm. This is more probable when, as sometimes happens, the symptoms are followed by a frank obstruction in part or whole of the retinal artery of that eye.

'Blacking out'

(*c*) *Obstruction of Central Retinal Artery*

Lodgement of an embolus was formerly accepted as the usual cause of arterial obstruction, but it seems definite that arterial thrombosis or even spasm, lasting long enough to produce visible signs and permanent damage, is responsible for most cases. *Incidence* Although young people may be affected, the large majority are elderly subjects of arterial disease.

Onset The onset is abrupt, but especially in elderly subjects the history is commonly that of waking in the morning to find one eye blind, as indeed it is, except for a little vague visual perception in the temporal field corresponding to the blind-spot and allowed by some slight retinal nutrition through the choroidal system round the optic disc. *Ophthalmoscopic appearances* The pupil is inactive, and examination of the fundus within a few hours of the obstruction shows that the whole central area is whitish and cloudy (see Fig. 71), with the red of the choroidal circulation showing through at the macula as the familiar cherry-red spot. In obstruction of a branch of the artery, the area supplied by the branch shows the white cloud of coagulation-necrosis of the retina. *Visual field* The visual field is lost in the quadrant corresponding to the damaged retina.

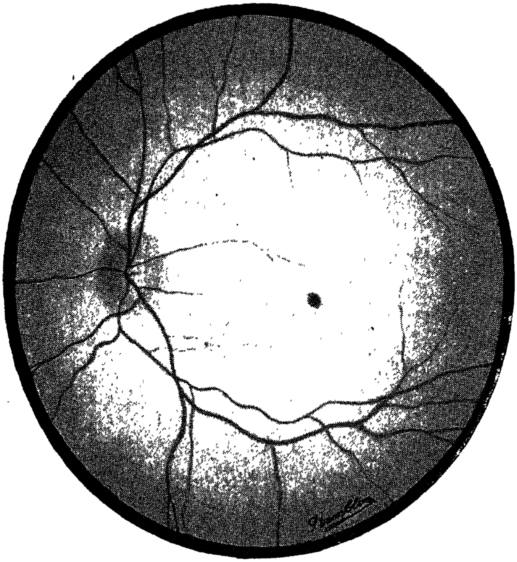

FIG. 71.—Obstruction of central retinal artery

In a few days the whitish area begins to clear and the retina appears normal again, save that in many cases the arterial system is much narrowed or obliterated. In some cases the artery fills again, possibly an indication of a spastic factor in the obstruction.

Optic atrophy In all cases some degree of optic atrophy results. In rare cases a full visual field is regained together with central vision; in others an absolute central scotoma remains, though the peripheral field is full. These are probably cases of spastic obstruction in which the deprivation of oxygen to the retina has been just below the degree required to destroy the cells entirely. In the very large majority of cases no return of vision is obtained, and blindness, due to complete optic atrophy, results.

Treatment

Paracentesis

Treatment is of very limited value and, to effect anything, must be very prompt. When an embolus is suspected, paracentesis of the anterior chamber is recommended, because the sudden fall in the intra-ocular pressure may drive the embolus, lodged in the main trunk at the lamina cribrosa, further into the arterial system and turn the block of the entire artery into obstruction of a branch only. Some success and many disappointments have been reported after early subconjunctival injection of acetylcholine; for example, 0·5 c.c. of a solution of acetylcholine bromide containing in each c.c. the equivalent of 0·1 gram of acetylcholine. When improvement follows this treatment, the possibility of a passing spasm must be borne in mind, because beyond doubt such cases occur. (See also Vol. II, p. 438.)

Acetyl-choline

(3)—Venous Thrombosis

Anatomical

This may occur in the central vein at the lamina cribrosa or in any branch; in the latter case the pressure of an overlying thickened artery is often the immediate cause. Thrombosis of a branch occurs much more often on the temporal than on the nasal side of the venous system, and in the upper more often than in the lower vein. The macular area, drained by these veins, is commonly damaged by the effects of the thrombosis.

Age incidence

Most patients are past middle age and often the subjects of arterial disease. Not uncommonly a vein may be seen thrombosed immediately distal to the point where it is crossed by a sclerosed retinal artery. Thrombosis in younger subjects, especially women, is observed, however, and the frequent absence of obvious arterial disease suggests an intravenous factor, presumably toxic, together with an alteration of pressure in the venous system.

Onset

The onset of thrombosis in a vein is much less abrupt than that of arterial obstruction, and the history of visual disturbance is often indefinite. The thrombosed vein is seen to be much engorged, black, and turgid, and haemorrhages and exudates occur in the retina over the area drained by the vein. In thrombosis of a central vein the disc is blurred by haemorrhages and exudates, which are spattered all over the fundus (see Fig. 72). They lie mainly in the nerve-fibre layer.

Ophthalmo-scopic appearances

It seems certain that partial thrombosis may occur, and then sparse haemorrhages only may be visible.

Vision

Visual acuity is usually grossly affected in a complete block, and even in thrombosis of a temporal branch the outpouring of blood is sufficient to damage the macular area. The visual field is not materially affected.

Glaucoma

Some patients with thrombosis of a central vein develop an intractable form of glaucoma within a few weeks of blocking of the blood-vessel, and these eyes usually have to be excised. Short of this a gradual clearance of the retinal changes takes place over a period of months, and central vision may improve. With severe damage at the onset, however, the retina and its function generally steadily deteriorate.

Collateral circulation

A striking feature in the recovery is the appearance of tortuous little new vessels on the disc in a central vein obstruction or towards the periphery of the retina in a branch thrombosis. They are very typical and represent the attempted establishment of a collateral circulation.

Treatment

No local treatment is of any avail, and general treatment must be directed to the cause if obvious. A thrombosis in the second eye seldom occurs, and the possibility of preventing such an event is very slight. (See also Vol. II, p. 438.)

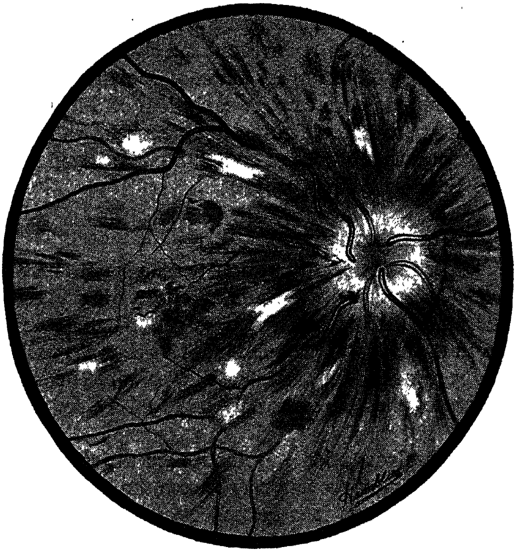

FIG. 72.—Thrombosis of central retinal vein

5.–DISEASES OF THE BLOOD-FORMING ORGANS

(1)—Anaemia

Incidence

1368.] Retinal changes have been described as occurring in the course of any profound anaemia. The present treatment of pernicious anaemia, however, has greatly lessened the frequency of the more distinctive changes, and considerable changes are rare in cases of anaemia following direct loss of blood.

Ophthalmoscopic appearances

The fundus as a whole may appear pale as part of the general bloodlessness, though this is by no means constant. More commonly the optic disc is noticeably pale. The blood-vessels, especially the veins, are sometimes distended, and arteries and veins may resemble each other more closely than is usual. This is more strikingly seen in secondary anaemia.

Haemorrhages

Haemorrhages of all types, but usually flame-shaped, are seen in the central part of the fundus, which may show a diffuse opalescence or haze. In secondary anaemia especially there are seen with the haemorrhages small cloudy areas of exudate indistinguishable from those characteristic of renal retinitis, and, if the disc is not pale, the fundus may very closely simulate that of an early stage of that condition. With an improved blood picture the haemorrhages and exudates clear without leaving any traces. (See also Vol. II, p. 441.)

(2)—Leukaemia

Retinal changes are probable at some stage of every case of leukaemia. The more severe changes are seen in the acute forms of the disease.

Ophthalmoscopic appearances

The veins, and in many cases the arteries, may be engorged and very often pale, both sets of vessels closely resembling each other—the evidence of the anaemia.

Characteristic haemorrhage

In a more severe case the veins may be much engorged, and haemorrhages are often present. These may be of any type, but a roughly diamond-shaped superficial haemorrhage with a white centre, presumably composed of aggregated white cells, is very characteristic. The optic disc is highly coloured and blurred, and the retina may, as in anaemia, closely resemble that of renal retinitis. All these changes can clear up completely with an improvement in the general state.

Leukaemic retinitis

A yet more advanced condition may be termed leukaemic retinitis, because there is intense leukaemic infiltration of the grossly disorganized retina. It appears thickened and orange or greenish, the vessels sometimes being buried, and the veins showing broad white lines due to perivascular infiltration. (See also Vol. II, p. 441; and Vol. VIII, pp. 2 and 24.)

(3)—Erythraemia

(*Synonym.*—Vaquez's or Vaquez-Osler's disease)

In this rare condition a striking retinal picture may be seen: extreme engorgement of the retinal veins with many flame-shaped haemorrhages round or near the optic disc. Thus the picture may closely simulate that of thrombosis of the central vein of the retina or even the papilloedema associated with a cerebral tumour.

(4)—Purpura

Retinal haemorrhages may be seen in purpuric states or conditions producing diffuse petechial haemorrhages. They are usually flame-shaped, occurring in the central part of the fundus.

6.–INFLAMMATION

1369.] Several conditions termed retinitis are not inflammatory in the strict sense of the word but are characterized by retinal exudates and haemorrhages, and vision may be grossly damaged by the changes and their effects upon the retinal cells and fibres. Choroidal inflammation, whether suppurative or non-suppurative, solitary or disseminated, always involves the retina, which is impaired to the extent of the choroidal damage. Such lesions are therefore often described as choroido-retinitis. (See also Vol. II, p. 426.)

(1)—Syphilitic Retinitis

Syphilitic inflammation in one form may be almost purely retinal. It occurs in congenital syphilis, as shown by its after-effects, and in the secondary stage of the acquired form. *Ophthalmoscopic appearances* The retina has a whitish milky look seen through a haze of vitreous opacity. As the active process subsides, the fundus is pale and the retinal vessels are attenuated and sheathed in white fibrous tissue. In the congenital form especially there is a fine dusty proliferation of pigment giving rise to the so-called 'pepper and salt' fundus. *'Pepper and salt' fundus* The optic disc shows consecutive atrophy.

Treatment Local treatment consists of atropine and the use of dark glasses; antisyphilitic treatment should be given, but its value in preventing the final atrophy is doubtful. (See also Vol. II, p. 426.)

(2)—Pyaemic Retinitis

Infected emboli usually lodge in the choroid, the retina being involved secondarily. Rarely, a primary endogenous pyaemic retinitis is seen, especially in such states as puerperal sepsis. White areas, accompanied by haemorrhages, occur. Beyond treatment of the pyaemic state little can be done, and the more virulent forms readily lead to a generalized endophthalmitis. (See also Vol. II, p. 426.)

7.–RENAL RETINITIS

(*Synonym.*—Albuminuric retinitis)

Retinal changes in nephritis

1370.] Retinal changes occur in various forms of renal disease, particularly in chronic interstitial nephritis. Retinitis in its more severe form is often seen in the nephritis associated with the toxaemia of pregnancy but apart from this is rare in acute nephritis. Cases were reported, however, in the primary acute nephritis known as 'trench nephritis'.

Incidence of renal retinitis The condition may be seen in quite young children, and at any age in adults. The blood-pressure is considerably raised in almost every case, the arteries being obviously damaged. Renal retinitis is always bilateral and is essentially a condition of severe retinal toxaemia, with *Ophthalmoscopic appearances* oedema usually severe in both the retina and nerve-head, haemorrhages mostly flame-shaped, and gross exudates of the cloudy and 'cotton-wool patch' type (see Vol. II, Plate IV, A, facing p. 426). These are mainly in the central parts of the fundus, and at the macula there is often the typical stellate figure made up of globules of exudate, running along folds produced by the internal limiting membrane, which is carried forward by oedema.

Retinitis of pregnancy

The retinitis of pregnancy often shows these changes in their most striking form, and so great may be the subretinal exudate that the retina may be detached, usually bilaterally in the lower part of the globe.

In some instances exudates are very scanty, and a considerable papilloedema, together with haemorrhages, may make the picture indistinguishable from that of the fundi in raised intracranial pressure. Retinitis of pregnancy rapidly subsides after the termination of pregnancy. When the case has been sufficiently severe to produce retinal detachment, this will subside without leaving any trace of its occurrence. In a severe case there is likely to be some damage left, but good vision is often restored, and the prognosis for life is much less grave than in the non-pregnancy cases. Retinitis is unlikely to occur in any subsequent pregnancy. See also page 96.

Prognosis

Apart from cases in acute forms of nephritis and in pregnancy the prognosis is very grave, and life may usually be measured in months, very few patients living beyond the long-accepted time limit of two years.

If the patient survives long enough, the retinal condition subsides, the fundus showing a fine dusty gleaming exudate scattered about, a few haemorrhages, and some areas of proliferation of pigment, usually peripherally. The vessels are narrowed and may show white lines along their courses. The optic disc shows a variable degree of secondary atrophy. (See also Vol. II, p. 427.)

8.–ARTERIOSCLEROTIC RETINITIS

1371.] In the later stages of retinal arterial disease exudates are not uncommon, and to such a picture the word 'retinitis' is commonly applied. It should be clearly understood that there is no change of pathological lesion. It is convenient, however, to have such a title for a picture which may resemble other fundus states called retinitis and yet be the result of a condition with a different aetiology and prognosis. As retinal arteriosclerosis is often associated with the retinitis of both renal disease and diabetes mellitus, the importance of correct assessment of the fundus evidence is very real. In many cases there is a grossly mixed aetiology, but the clues given by the retinal changes aid the general findings in any particular case, especially as regards a prognosis as accurate as possible. The prognosis is much more favourable when the vascular factor predominates than when failure of renal function is evident.

Incidence

Ophthalmoscopic appearances

Arteriosclerotic retinitis is often unilateral, whereas renal retinitis is always bilateral and is confined to the middle-aged or elderly. It does not cause retinal oedema, and in addition to the gross arteriosclerosis there are centrally scattered fine white gleaming spots of exudate, 'harder' looking than those of diabetic retinitis. The haemorrhages accompanying the arterial changes are usually small and flame-shaped.

Course and prognosis The fundus picture changes very slowly, the patient often surviving several years, although life in the presence of retinitis may be expected to be shorter than when there are less evidence of arterial disease and no other changes. (See also Vol. II, p. 439.)

9.—DIABETIC RETINITIS

1372.] The retinal changes seen in diabetes mellitus are present in middle-aged or elderly patients and are very rarely seen in the severe diabetes mellitus of early life.

They are commonly, but not constantly, associated with retinal arterial disease, and the condition forms a definite clinical entity characterized by central changes consisting of small round or rosette haemorrhages and small sharply defined areas of yellowish-white, cheesy, or waxy-looking exudate (see Fig. 73). There is no oedema of the retina or optic disc. Both eyes are affected.

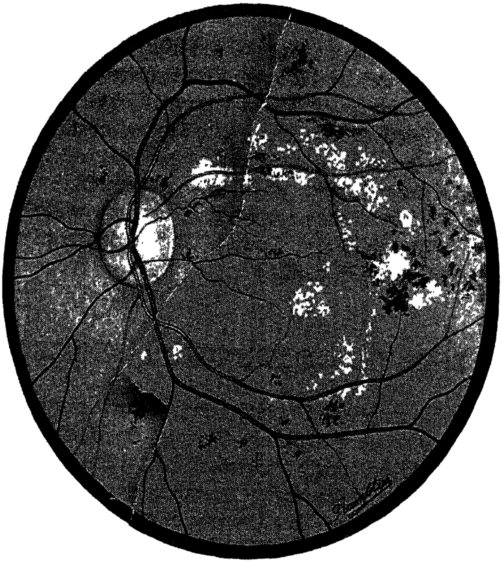

FIG. 73.—Diabetic retinitis

Ophthalmoscopic appearances

Causation The causation of the changes is obscure, and they appear independent of the blood-sugar or urinary-sugar levels.

Course and prognosis They do not provide an index of the patient's state and may be present for many years. Individual haemorrhages and patches of exudate may disappear and others appear; but, in view of the changes, reasonably good and constant vision is often maintained, and serious decline occurs only as the result of grosser intra-ocular haemorrhages or cataract.

Treatment

Insulin or any other treatment of diabetes does not influence the retinal changes. (See also Vol. II, p. 427.)

10.–LIPAEMIA RETINALIS

1373.] This very rare condition is sometimes seen in grave diabetes mellitus in young subjects.

Ophthalmoscopic appearances

Both the arteries and the veins are flattened and appear as though filled with a milky fluid. This appearance is associated with a high percentage of fat in the circulating blood and, when well marked, is certain evidence of a very grave metabolic disorder. (See also Vol. III, p. 647.)

11.–EXUDATIVE RETINITIS

(*Synonym.*—Coats's disease)

Definition

1374.] Although anomalous cases with retinal exudation are sometimes described under this heading, it is perhaps best kept for a definite entity seen in children and young subjects, mainly males.

Aetiology

Its aetiology is very obscure, because, although vascular changes, i.e. dilated vessels and aneurysms, may be seen, it does not otherwise appear to be related to retinal angiomatosis. Familial incidence has not been described. There is no evidence of any abnormal general state of blood-vessels or blood content, and no lesions are found in other parts of the body.

Morbid anatomy

Section of any eye removed for the condition shows cavitation of the retina, the cavities being filled with coagulum in which disintegrated red blood-cells and ghost cells are seen. There is considerable fibrosis, but no sign of inflammation.

Ophthalmoscopic appearances

In the early stages scattered discrete areas of deep retinal exudate are seen, not necessarily confined to the central part of the fundus. Haemorrhages are present but not wide-spread. Later, peripheral vascular changes appear, small aneurysms on fine arterial twigs, and sometimes arteriovenous dilatations or aneurysms.

Detachment of retina

Gross sub-retinal exudation sooner or later causes detachment of the retina, and this and organized changes in the vitreous may be followed by secondary glaucoma, for which excision of the eye may be necessary.

The condition is unilateral. No effective treatment is known.

12.–RETINITIS PROLIFERANS

Definition

1375.] This term is somewhat loosely applied to several conditions characterized by the formation of fibrous strands coming forwards from the retina, usually near the optic disc, into the vitreous.

Types

Types may be roughly classified thus: (i) following perforating wounds into the vitreous; (ii) following haemorrhage into the vitreous, either idiopathic or traumatic, the clot being invaded by fibroblasts, and in some cases new blood-vessels, from the retina; and (iii) spontaneous in young people who show clean-cut fibrous strands without any associated factor, or in older people often the subjects of chronic toxaemia. In these latter cases the vitreous becomes progressively opaque, and the eye may become disorganized.

Treatment No treatment is of any proved value, and the condition must be regarded with anxiety, because in some cases in otherwise sound eyes contracture of the fibrous bands may detach the retina.

13.–RETINITIS PIGMENTOSA

(*Synonym.*—Pigmentary degeneration of the retina)

Definition 1376.] This is slowly progressive atrophy of retina and choroid characterized by pigment proliferation and migration of a characteristic type. Thus, in spite of its name, it is in no way inflammatory.

Aetiology The disease is hereditary, many members of a family being affected, and is not uncommonly associated with consanguinity of parents (see Vol. V, p. 231).

Causation The distribution of the changes in the earlier stages, the choroidal changes, and some slight experimental evidence suggest a choroidal vascular lesion as the cause of the condition. The view has been advanced, however, that the condition is due to an abiotrophy of the retinal neuro-epithelium.

Onset The disease begins in childhood or early adult life as a degeneration of the superficial layers of the choroid. It is always bilateral. The first symptom is impaired vision in the dusk (night-blindness); in a good *Vision* light central visual acuity will probably be normal; but, if the patient is able to co-operate sufficiently well, the visual field will show a partial *Ophthalmoscopic appearances* or complete ring scotoma. At this stage the fundus picture may be normal, but later the retina in the equatorial region is seen to be studded with pigmented spots of a spidery shape, often likened to bone corpuscles (see Fig. 74). These lie superficially in the retina, tending to aggregate near or in front of the blood-vessels. This migration of pigment leaves the pigment epithelium decolorized, with the result that the larger choroidal vessels become more clearly visible.

Course As the disease progresses, the pigment migrates peripherally and gradually centrally also, the macular region being the last to become involved. The visual field gradually shrinks, although good central vision is often maintained until very late in the course of the disease. The retinal arteries become attenuated and the optic disc atrophic, showing the waxy yellowish-white colour typical of atrophy following *Cataract* retinal degeneration. Complicated cataract, beginning as a posterior cortical opacity, often appears in the later stages. The rate of progress of the condition varies greatly; in some cases useful vision is lost in middle adult life, whereas in others the rate of progress may be so slow that the degeneration seems to have been arrested.

Retinitis pigmentosa sine pigmento

The degree of proliferation of pigment varies within wide limits, and occasionally all the symptoms and signs are present except deposits of pigment in the retina. This type is probably only a variant of the usual picture, and in some cases at least sparse proliferation of pigment is seen sooner or later (see also Vol. II, p. 436). The deposits of pigment always conform to the same shape, and larger areas of pigmentation without the spidery shape make a careful review of the diagnosis essential.

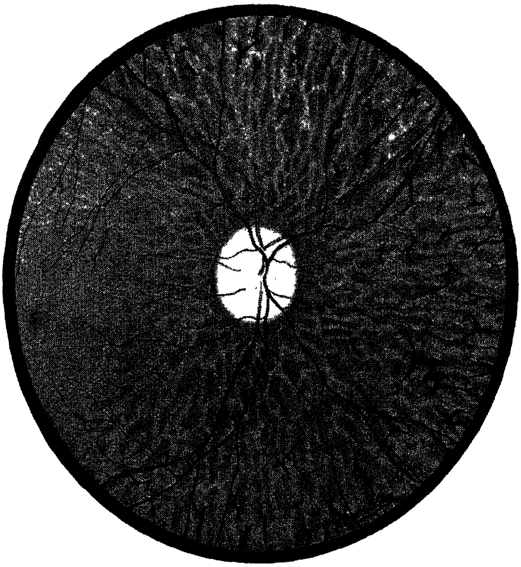

FIG. 74.—Retinitis pigmentosa

Associated conditions

Retinitis pigmentosa is not uncommonly associated with other congenital defects, such as mental deficiency, deaf-mutism, and skeletal changes, and forms part of the Laurence-Moon-Biedl syndrome (see Vol. III, p. 37; and Vol. IX, p. 624).

Diagnosis from old choroido-retinitis

In a typical familial case the diagnosis is not difficult, but isolated cases may be hard to differentiate from some forms of old choroido-retinitis. As these may be quite stationary, an accurate diagnosis is important in view of the prognosis. The inflammatory cases tend to show coarser and more shapeless areas of pigment; and, if the macula is relatively severely involved or the choroid is scarred, the case may be safely regarded as old choroido-retinitis.

Treatment

Treatment is unsatisfactory, as might be expected in a familial disease of this nature. On the basis of its vascular origin vasodilators, such as menformon, a preparation of ketohydroxyoestrin which acts as a vasodilator, have been widely used, and some success has been reported.

Division of the cervical sympathetic has been advocated and performed, but with no convincing success. In a disease so slowly progressive as to appear stationary over long periods the assessment of the value of any treatment at any stage requires considerable discrimination.

Extraction of the lens, if cataract develops, may help somewhat but is often disappointing. (See also Vol. II, p. 435.)

Retinitis punctata albescens

Retinitis punctata albescens is a rare fundus picture—probably a variant of retinitis pigmentosa—in which the retina is studded with small white areas. The symptoms and the incidence of retinitis pigmentosa in other members of the family associate the two conditions, but in the few cases seen with the white retinal deposits the loss of vision is less inexorable, and optic atrophy is not present.

14.–TUMOURS

(1)—Glioma Retinae

Definition

1377.] This is a highly malignant intra-ocular tumour, probably always congenital, in any case never seen after early childhood.

Incidence

The disease is rare, in some instances has a strong familial incidence (see Vol. V, p. 236), and is bilateral in about 25 per cent of the cases, the tumour appearing independently in both eyes simultaneously, or in the second eye some months after the first.

Morbid anatomy

The tumour originates in the foetal retinal cells and has not any relation to glioma of the brain. It consists of small round cells, among which are rosette-like formations. The mass becomes lobulated, the cells in the centre of the lobules readily undergoing necrosis. Multiple areas of tumour are commonly seen.

Clinical picture

The child is usually brought because the parents have noticed an unusual light reflex from one pupil, the so-called 'cat's eye reflex'. It is not until the later stages that the external appearances are abnormal, but with certain incidence of light the whitish yellow reflex from the pupil is readily appreciated.

Ophthalmoscopic appearances

The tumour is seen as a dirty-white flocculent or polypoid mass, if well advanced, and satellite areas floating in the vitreous or implanted elsewhere in the eye may be present. Loops of new capillaries may be seen on its surface. A very early tumour if present in the second eye appears as a localized whitish area only.

Course and prognosis

If left untreated the tumour increases in size, may raise the intra-ocular tension, spreads by extra-ocular extension after perforation of the globe, and infiltrates along the optic nerve to the brain. Distant metastases are rare. Rare but authenticated cases of self-destruction of the tumour with shrinkage of the eye have been reported, but except for these cases prognosis of an untreated case is hopeless.

Treatment

If the eye containing the tumour is excised and the optic nerve divided behind any extension, the child is relatively safe except for the possibility of a tumour affecting the second eye, because metastases are rare and late.

Differential diagnosis

From pseudoglioma

Two conditions give rise to difficulty in diagnosis. In the so-called pseudoglioma, massive organized tissue in the vitreous occurring after uveitis, other evidence of the past inflammation, e.g. iris synechiae, may be seen, and the intra-ocular tension may be lowered.

From congenital defects

In congenital defects due to persistence of the fibrovascular sheath behind the lens, the detail is usually clearer than in glioma, and the mass is apparently fibrous, with sometimes a conspicuous sheaf of blood-vessels at some point.

Both eyes should always be examined under general anaesthesia and with wide dilatation of the pupils; and, if there is reasonable doubt, the case should be regarded as one of glioma and the eye excised, because if the condition is pseudoglioma, the eye will eventually be worthless.

Treatment

An eye containing a retinal glioma should be excised without delay, the optic nerve being divided as far back as possible. If a gross tumour is present in both eyes, the parents should be strongly persuaded to allow the second eye to be removed, because many cases have been reported in which the child has survived after removal of both eyes for glioma. If the eye is retained, a most distressing course of events with a fatal result must be expected. If there is only a small tumour in the second eye, radiotherapy by suturing radon seeds of a strength of two millicuries over the affected area is justifiable, and highly successful results have been recorded. If the second eye is normal when the other is removed, the parents must be warned of the possibility of its involvement, and the eye must be examined carefully at regular intervals for a period of five years. (See also Vol. II, p. 431.)

Radiotherapy

(2)—Lindau's Disease

See LINDAU'S DISEASE, Vol. VIII, p. 55.

(3)—Epiloia

See EPILOIA, Vol. V, p. 117.

(4)—Neurofibromatosis

See NEUROFIBROMATOSIS, Vol. IX, p. 214.

15.—MACULAR LESIONS

1378.] Although it may not be justified on pathological grounds, there is considerable clinical reason for grouping the macular lesions together. Accidental trauma or a patch of inflammation affecting the macular area of one eye does not come into such a grouping, but several clinical entities affecting both maculae and running true to type can be assembled. (See Vol. V, p. 226.) The reason for such selectivity of site and whether the lesion is primarily retinal or choroidal are questions not easily answered, but the specialized anatomy of choroid and retina together with the critical function of the central area of retina must provide the reasons for the very definite lesions seen. Grouping by clinical picture or apparent causation is often very difficult, because fundus pictures closely resembling each other may result from obviously widely different morbid conditions. Degenerative states, however, form the large majority of cases.

(1)—Congenital

Coloboma

Tapeto-retinal degeneration

Congenital nystagmus

Macular colobomas with familial incidence may be justly put into this group together with the ill defined type of cases described as tapetoretinal degeneration. Congenital nystagmus, when not associated with albinism, may be due to a macular developmental fault (see also Vol. IX, p. 264).

(2)—Inflammatory

Minor degrees of macular hyperaemia are described as causing temporary visual disturbance in the course of toxic states such as influenza. Variations in the normal macular appearance, however, make such a diagnosis uncertain.

Definite acute macular disturbance of both eyes, however, is seen, sometimes in the course of an acute specific fever, sometimes without obvious causation. The onset is acute, and central vision is grossly affected as the result of retinal oedema.

Treatment

On subsidence of the active process an area of blotchy pigmentary disturbance is left, sometimes sharply defined, strikingly symmetrical, and resembling a moth-eaten fabric. Vision is permanently damaged. Treatment is limited to resting the eyes, wearing dark glasses, and attending to any discovered cause.

(3)—Degenerative

(*a*) *Senile*

Although some, possibly all, of these conditions are choroidal in origin and probably the results of choroidal vascular changes, the fundus changes must be considered with the more definitely retinal degenerations.

(i) *Colloid body formation*

(*Synonyms.*—Tay's choroiditis; guttate choroiditis)

Small colloid or hyaline excrescences are often present upon the lamina basalis (Bruch's membrane). In some cases they are probably congenital because they may be seen scattered widely over the fundus of a young person. More commonly they are seen in middle-aged or elderly people, when they are more usually centrally distributed. Although definitely a choroidal change they are readily confused with retinal lesions.

They appear as discrete yellowish-white areas, sometimes irregular or crenate in outline, but more commonly circular. A little 'stressing' of pigment may be seen round some. They do not affect vision; but, as they are often associated with degenerative or chronic inflammatory states, the visual acuity may be impaired by the primary lesion.

It is important that their nature and significance should be recognized, because to them may be erroneously ascribed the defective vision resulting from some other lesion, e.g. tobacco amblyopia, the evidences of which may be overlooked in the presence of visible fundus changes, such as colloid bodies.

(ii) *Low-grade central degeneration*

Localized pigmentary disturbance with a mottled macular area of atrophy of retina and choroid is common in elderly people. The condition is bilateral and often very symmetrical. Central vision is grossly impaired, but the degeneration is always strictly confined to the macular area, with the result that a full peripheral field of vision is retained. No treatment influences the condition.

(iii) *Central areolar atrophy*

Less often a much more wide-spread symmetrical bilateral atrophy of the central fundus area is seen in old people. The larger choroidal vessels are exposed, and the atrophic patch is commonly ringed by colloid excrescences. As with the low-grade changes, these patients never become blind, although central vision is lost. The condition is unaffected by treatment.

(iv) *Exudative degeneration*

(*Synonyms.*—Senile exudative macular retinitis; disciform degeneration of the macula)

This type of central degeneration is characterized by exudation which is sometimes considerable. The changes are bilateral, although months or occasionally years may pass before the second eye is affected. The exudation may start as a deep haemorrhage, as a wide-spread exudation apparently lacking the formed elements of blood, or as small localized areas of opaque exudate which later coalesce to form a mass. It is commonly sharply outlined but may be irregular, and pigment migrates into the mass in the later stages. The exudate becomes organized from the pigmented layer, settling into a disciform plaque of tissue obliterating the central retina.

Diagnosis from exudative retinitis

It is always confined to the macular area, and good peripheral vision is maintained. This fact and the extreme age of the patients differentiate it from the unilateral exudative retinitis (see p. 625).

(v) *Retinitis circinata*

A striking picture, originally described as a separate entity, is occasionally seen in association with exudative degeneration of the macula. A partial or complete ring of discrete whitish spots of bright exudate encircles the central area. Patches of the circinate exudate can be seen to form and disappear, and a complete ring is common. No special feature of the macular lesion seems responsible for this form of exudate, and the scanty evidence suggests that it is made up of spots of fatty degeneration—possibly of blood-cells from the exudate (see also Vol. II, p. 426).

(*b*) *Cerebro-Retinal Syndromes*

See Vol. III, p. 30.

(*c*) *Familial Macular Degeneration*

(*Synonym.*—Stargardt's disease)

A condition of bilateral macular degeneration without any evidence of associated cerebral changes is sometimes seen. It shows a strong familial incidence and runs true to type in being apparently only an ocular state. The disease begins at, or rather before, puberty and runs a slowly progressive course, affecting only central visual acuity.

The impairment of vision is due to a circumscribed mottled area of macular degeneration in each eye. The atrophic area increases slowly in extent but always appears confined to the superficial layers of the choroid and the retina. No treatment influences the course of events.

(*d*) *Angioid Streaks*

These are brown or reddish streaks lying deep to the retinal vessels, often roughly concentric with the optic disc, with radiations further towards the periphery. The streaks appear ribbon-like, somewhat resembling choroidal blood-vessels, but vary considerably in size and shape.

They may form an isolated picture but are often associated with degenerative lesions in the fundus, especially those in the macular region, e.g. exudative degeneration. They are not associated with obvious vascular lesions.

As these eyes seldom become available for pathological investigation, the causation of the streaks has been obscure, but recent evidence confirms the view that they are due to splitting of the lamina basalis (Bruch's membrane). There is some evidence of familial incidence, and a high proportion of cases are associated with a general disease of the elastic connective tissue of the body.

16.–DETACHMENT

(1)—Definition

1379.] This is strictly a splitting of the retina whereby the inner layers, the cells and fibres, become detached from the pigmented layer, which remains attached to the choroid.

(2)—Aetiology

The cause of a retinal detachment may be obvious as part of a gross intra-ocular change. The retina may be pulled off by the organization of obvious inflammatory or haemorrhagic exudates in the vitreous or pushed off by gross exudation, as in the retinitis associated with nephritis in pregnancy, or by a choroidal tumour or exudate.

These obvious causes account for a small proportion of cases. Of the much larger proportion of less obvious causation the vast majority show a breach in the retina—the retinal hole or tear—and the generally accepted view is that the retinal tear, however caused, allows fluid to collect beneath the inner layers of the retina and to flood them off the pigmented layer. *Retinal tears and holes*

Of all these cases myopia is present in about 60 per cent (see Vol. IX, p. 67). More than 90 per cent of tears are in front of the equator of the eye and 80 per cent in the temporal half. The commoner types are horseshoe or arrow-head shaped tears, round holes, and tearing away of the retina from its attachment at the ora serrata—the so-called disinsertion or anterior retinal dialysis. Multiple holes are found in 25 per cent of cases. An obvious trauma accounts for a large number of the long tears at the ora serrata, partly because of the loose attachment here and perhaps partly from gross trauma rupturing a degeneration cyst of the retina. Minor changes in the vitreous causing adhesion to the retina at some point, and then traction causing the tear, probably account for the high incidence of detachment in myopia and the formation of arrow-head holes. Round holes, especially if multiple, may arise from insignificant patches of old choroido-retinitis, or from the rupture of a retinal degeneration cyst. These cysts are common in the extreme retinal periphery. Slight degrees of trauma, direct or indirect, probably play a considerable part in determining the moment of hole formation in many of these types. *Myopia* *Types of tears* *Disinsertion* *Causes of tears* *Trauma* *Changes in the vitreous* *Choroido-retinitis* *Cysts*

(3)—Classification

Analysis of the evidence suggests four broad types of simple retinal detachment: (i) those in the earlier decades in which males predominate because the trauma factor is high; they are not myopic eyes, and the incidence of 'disinsertion' tears is high; a small sub-group shows symmetrical lower temporal detachment in each eye; (ii) those in the fifty and sixty age-periods in which the sexes are equal and the myopic incidence high; the holes are arrow-head or round and often upper temporal in position; (iii) those with round holes, often multiple; the age period and aetiology are less clear; and, (iv) those occurring in aphakia, often years after the discission of a lens in earlier life, but when seen after cataract extraction appearing much closer to the date of operation. Holes are notoriously difficult to find in aphakic detachments.

(4)—Clinical Picture

A history of gross trauma to the eye or its neighbourhood will be given in many cases and should always be sought. The existence or otherwise of myopia must be determined. *History* *Refraction of the eye*

A patient in whom a retinal detachment is impending often gives a history of flashes of light in some part of the visual field, sometimes accompanied by 'spots before the eyes'. These symptoms may be noticed a considerable time before the actual detachment and should be regarded as serious, and the patient should be carefully examined *Premonitory symptoms* if of the type in whom subsequent detachment may be suspected, e.g. high myopia. Resting the eyes and keeping the patient in bed may avert catastrophe.

Symptoms of actual detachment

When the retina becomes detached, the patient notices increased 'spots before the eyes' and a veil or cloud in the visual field. A good observer, if questioned, will often help in the localization of the retinal tear by his account of the direction in which flashes of light or the veil were first seen.

Signs

In a simple detachment, i.e. one not associated with choroidal sarcoma, the eye usually appears normal externally. A traumatic case may show external signs of trauma, e.g. ecchymosis.

Pupil

The pupil is often larger than its fellow and reacts less briskly and fully to light. The intra-ocular tension, if not normal, is usually lowered.

Vision

The visual acuity is usually depressed but may be full if the detachment has not involved the central retinal area. The field of vision is always curtailed, the degree depending on the extent of the detachment.

Fundus reflex

Retina

The fundus reflex from the detached area is grey or dark instead of the normal red—a very important sign—and the ophthalmoscope shows the retina over the detached area to be in focus far in front of the general fundus level (see Vol. V, p. 226). It has a greyish or darker appearance if fairly transparent, but the more opaque it is the whiter does it become. (See Vol. II, Fig. 70, p. 418.) It is ballooned, cystic-looking, or thrown into undulations according to the nature of the case, and the blood-vessels over it look dark and tortuous. The tear or hole is seen as a glowing red area in the detachment, the edges usually being sharply defined. The tear may be difficult to find, several examinations being necessary on successive days with the patient in various positions on the different occasions.

Tear

(5)—Course and Prognosis

Spontaneous reattachment

Once the retina is detached at any point, its spontaneous reattachment is very rare, except in cases associated with intense retinal oedema. The sub-retinal fluid tends to gravitate to the lower part of the fundus, and thus the area detached may increase in extent, up to totality, or merely be altered in position.

Younger people

The detachments seen in younger people, of traumatic origin and especially the bilateral types, often remain for long periods confined to the lower and temporal part of the fundus. The media remain clear, and useful central vision may be retained with a good lower and temporal field.

Older people

Detachments in older people, especially the myopic, tend to increase, involving most of the retina. The media lose transparency both from the vitreous opacification of a low-grade uveitis and from the development of a complicated cataract.

Cataract

Operative prognosis

Operative success must be judged from two view-points: (i) successful replacement of the retina with consequent recovery of visual field, a most valuable gain; and (ii) improvement of central vision.

Quoted figures for successful replacement vary very much, but perhaps a reasonably accurate estimate can be obtained from the following divisions: *Replacement*

(i) '*Inoperable cases*': (*a*) long-standing wide-spread detachments, especially those in which uveitis and cataract have developed; and (*b*) patients for whom the post-operative demands are too great.

(ii) *Poor to moderate prognosis.* These cases vary from almost hopeless up to perhaps 30 per cent success and include the highly myopic eyes, the gross traumatic tears of the retina, and detachments showing multiple holes and a degenerate-looking retina. 'Aphakic' detachments come in this group, particularly because immediate successful reattachment is so often followed within weeks or perhaps months by recurrence of detachment. *'Aphakic' detachments*

(iii) *Good prognosis.* Young subjects with disinsertions, whether traumatic or not, with single round holes, and moderate myopes with single holes may expect 50 per cent or more success, even if more than one operation must be undergone to achieve the success.

The recovery of good central vision depends on the macular region being spared by the detachment or so recently separated that its nutrition has not yet suffered materially. A very guarded prognosis for central acuity should always be given, even if a successful replacement of the retina is considered likely. The full field obtained and the prevention of progressive decline in value of the eye are very great gains, especially because the prospect of reattachment of the retina without operation has always been extremely remote. *Recovery of vision*

(6)—Diagnosis

This is based on the points given in the clinical picture. Mistakes are usually due to inefficient examination failing to reveal the presence of a detachment.

Differential diagnosis is essentially the decision whether the detachment seen is the result of a choroidal growth or whether it has some other cause. Decision may be difficult, because neither age, sex, history, nor clinical picture may assist. The following points help particularly in the differential diagnosis. A less abrupt onset with perhaps a sudden increase in symptoms may point to tumour formation. A group of dilated superficial blood-vessels is sometimes seen in the quadrant of the globe within which is a tumour. The detached area in sarcoma appears to be solid, and part of it may be dark or almost black. Definite areas of aggregation of pigment are very suggestive, and the diagnosis is almost certain if just beneath the retinal blood-vessels can be seen a second circulatory system, the vessels in the choroidal tumour. *Differential diagnosis* *History* *Superficial changes* *Appearance of detachment in sarcoma*

Transillumination of the normal eye-ball gives a uniform glow in the pupil from all directions, but the pupil 'red' may be much diminished from a direction in which an opaque mass reasonably far forward in the globe is interfering with the transmission of light. *Trans-illuminatio*

Intra-ocular tension In the later stages the intra-ocular tension may be raised in the presence of a tumour.

(7)—Treatment

(*a*) *Preventive*

Traumatic detachments may perhaps be lessened in frequency if rest is always made part of the treatment of severe trauma to the eye. The regime of highly myopic patients, especially if a detachment has occurred in one eye, should be regulated, especially with regard to any exertion involving stooping or straining. An impending catastrophe may be averted if threatening symptoms are made the occasion for rest and care by the patient.

(*b*) *Surgical*

Choroidal sarcoma If the evidence favours the presence of a choroidal sarcoma as the cause of the detachment, the eye should be excised without delay.

'Inoperable' group If the case comes within the 'inoperable' group (see p. 635), either from the local or general state of the patient, little can be done, and only if the eye gives rise to pain from secondary causes should excision be considered.

Cases for operation If the condition of the patient and the local condition offer any reasonable hope of success by operation, this should be undertaken without delay. If the detachment is recent and the central vision still good, operation should be considered almost as an emergency and undertaken as soon as possible after the hole is located.

Preparation Before operation the patient should be kept as quiet as possible and the eye treated with a drop of a 1 per cent solution of atropine sulphate daily.

Operation The essential aim of operation is the closure of the retinal hole. Short of this some degree of success may be obtained by seclusion of the detached area with scar tissue, even if the hole is not sealed.

Gonin's method All recent successful operative treatment is the outcome of the work of the late J. Gonin, of Lausanne, who insisted that success could only follow the closure of the retinal hole. His practice briefly consisted of: (i) the very accurate localization of the hole and the estimation of its position relative to the external surface of the sclerotic; (ii) the puncture of the sclerotic at the estimated point and the insertion of the Paquelin cautery into the eye-ball; and (iii) absolute rest in bed for at least two weeks after operation.

Drawbacks Many successful results were obtained in all parts of the world by his method, the main drawbacks to which were: (i) the difficulty of accurate localization; (ii) the necessity of repeated operations for large tears; and (iii) severe reactions in the vitreous.

Chemical methods *Electro-coagulation* Later, chemical methods for producing reactions within the eye-ball were introduced, but these soon gave place to electro-coagulation methods. Three main methods are used, singly or in conjunction with each other: (i) surface diathermy, in which a blunt applicator is applied to the sclerotic at many points over the detached area, especially in the region of the hole; it carries a current of approximately 70 milliamperes and is in contact for 8 to 10 seconds at each point; as a modification the amperage is not estimated, and the heat engendered at the terminal is estimated and regulated; (ii) puncture diathermy, in which a needle applicator is introduced through the sclerotic into the choroid and a current of 30 to 40 milliamperes sustained for 2 to 5 seconds; this is repeated over the area under treatment; and (iii) the kathode terminal in the form of a fine needle is introduced into the eye-ball and held there for 1 to 2 seconds, while a low voltage direct current of a few milliamperes is passed. Multiple punctures are made.

Surface diathermy

Puncture diathermy

In all these methods the intention is to produce a reaction within the eye-ball, the subsequent scarring of which will bind retina and choroid firmly to the sclerotic, especially involving the breach in the retina in the scar tissue. In order that this may be effected, the fluid must escape from beneath the detached area of retina. In puncture diathermy the punctures allow drainage, but in surface diathermy drainage must be effected after diathermy by trephining off a disc of sclerotic and puncturing the exposed choroid.

The operation is done under local anaesthesia and, though sometimes tedious, is not otherwise exacting, especially if the extra-ocular muscles are not pulled on. Complete rest in bed for at least two weeks is essential.

After-treatment

After-treatment of a successful operation consists of wearing pin-hole glasses which limit the movements of the eye, and a gradual return to normal active life.

Repeat operations

Repeat operations may be undertaken and are often successful, but the strain upon the patient's health, time, and pocket must be carefully weighed against the estimated value of further operation.

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RHEUMATIC HEART DISEASE IN CHILDREN

See HEART DISEASES, Vol. VI, p. 234

RHEUMATIC INFECTION, ACUTE

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Reference may also be made to the following titles:

CHOREA
HEART DISEASES: RHEUMATIC HEART DISEASE IN CHILDREN

1.–DEFINITION

(*Synonyms.*—Acute rheumatism; rheumatic fever; juvenile rheumatism)

1380.] Any definition of acute rheumatism must at present remain to some extent an expression of personal opinion. Some bacteriologists still deny that it is a streptococcal disease or a bacteriaemia, but the following definition will probably satisfy physicians interested in juvenile rheumatism. Acute rheumatism is associated with a haemic infection by a non-pyogenic streptococcus which sets up in the affected organs a characteristic tissue-reaction, and in the patient a predisposition to further attacks; its incidence falls with peculiar heaviness on the poorer classes, and its first attacks are commonest in children of school age; its chief clinical features are tonsilitis, fibrositis, arthritis, carditis, chorea, and nodules, the last three of which are of a type almost peculiar to the disease (Miller, 1933).

The active phases of acute rheumatic infection are seen most frequently and at their worst during childhood, and therefore the full significance of the disease can only be appreciated when it is described as a disease of children, showing modifications when it occurs in adults. Further, there is no doubt that for some decades the general severity of the infection has been diminishing: thus hyperpyrexia has virtually disappeared; 'rheumatic fever' is hardly ever seen; and the incidence of acute pericarditis has notably lessened. Lastly, although experience in London leads to the hope that a diminution in the frequency as well as in the severity of the disease has now set in, juvenile rheumatism still remains a very important problem in public health and one closely connected with the standards of living of the poorer classes.

2.—AETIOLOGY

The acute rheumatic infection not only produces a clinical picture which is repeated with complete accuracy in case after case, but it is also responsible for a very characteristic tissue-reaction in the affected organs. These facts seem to prove that the infecting micro-organism is capable of acting as a specific agent *in certain circumstances and within the human body*. More than that they do not prove, and thus in the production of acute rheumatism bacteriological and clinical factors are of almost equal importance. In a certain set of conditions the infecting agent gains access to the blood-stream, usually through the nasopharynx, especially the tonsils. On arrival in the tissues it sets up its characteristic tissue-reaction and tends to die down, the disease being prolonged by repeated reinfections.

Age and sex incidence

Acute rheumatic infection appears to be commonest at that time of life when the diminished resistance of childhood, exposure, and tonsillar sepsis overlap. Thus it is almost unknown during the first two years of life and is uncommon under five; it reaches a maximum, as regards first attacks, at the age of seven or eight years, and remains frequent until puberty. During adolescence and young adult life primary attacks are still seen, and recrudescences may occur in rheumatic subjects up to and even after middle age. The disease as a whole is rather commoner in females than in males. Chorea is almost three times more frequent in girls than in boys, and in adults is almost confined to pregnant women. Acute rheumatism may be seen in all types of children; those with a red tinge in their hair appear particularly prone to the infection.

Heredity

Hereditary predisposition to the infection was formerly much emphasized, but in a disease which is so common, so massed in a particular stratum of society, and so much influenced by environmental factors, it is difficult to assess the significance of inheritance. The influence of environment, however, is paramount. Acute rheumatism is a disease of temperate climates, follows rivers and water-courses, and is particularly common in low-lying districts. It is a winter disease, though no season of the year is immune. It is a disease of urban rather than of rural districts, and of industrial towns in particular.

Environment

Class incidence

The class incidence is specially important; from whatever angle the incidence of juvenile rheumatism is examined, it is found that the disease is massed in the poorer classes. The upper social limit of the rheumatic stratum of society seems to correspond to the class attending the State elementary schools. In these children rheumatic heart disease occurs in about 1 per cent of entrants and in 2·5 to 5 per cent of leavers. In the private and public schools of the well-to-do classes the disease is definitely rare. The same disparity is seen in the incidence of rheumatism in hospital and in private paediatric practice.

Poverty

In an analysis of the effect on the occurrence of the disease of the various aspects of poverty, it is found that its frequency does not increase as the lowest depths of poverty are reached. Squalor, overcrowding, malnutrition, and the other concomitants of extreme poverty do not seem to be of great moment, for there is as much juvenile rheumatism, if not more, in the upper artisan stratum of the poorer classes as in the lower. Consequently it is possible that housing is important in this connexion, and it may be that from the point of view of rheumatic infection it is less dangerous to live in an overcrowded kitchen in a slum than in the damp cold jerry-built houses of comparative poverty. It seems certain that the incidence of the disease is high among basement-dwellers. There is no evidence that rheumatism itself spreads from case to case.

Housing

Contagion

Infected tonsils

The association between tonsillar infection and acute rheumatism is particularly close, and 80 per cent of rheumatic children show chronic tonsillar sepsis. The tonsils are seldom large and obstructive, but are of the small buried type which show their unhealthiness by the reddening of the faucial pillars over them. Attacks of tonsillitis often determine the onset of fresh rheumatic infection. The presence of chronic tonsillar infection predisposes to colds and sore throats, and thus increases the frequency of the acute rheumatic attacks, tends to prolong the attacks, increases their severity, and notably predisposes to carditis. Tonsillar sepsis also explains the presence of rheumatic heart disease in persons who are unaware that they have suffered from 'rheumatism'.

Exciting factors

The commonest incident which determines the onset of an attack of acute rheumatism is an acute infection of the throat, tonsillar or pharyngeal. Tonsillitis will arise almost spontaneously in a rheumatic child, but usually there is some associated chill or catarrhal cold. Catarrhal epidemics due to haemolytic streptococcal infections are peculiarly dangerous from this point of view and will excite rheumatic attacks through pharyngeal infection even in tonsillectomized children. Scarlet fever, diphtheria, and measles will act by the same means, and it is rare for a rheumatic child to escape acute rheumatic symptoms after an attack of scarlet fever.

3.–BACTERIOLOGY AND MORBID ANATOMY

Diplo-streptococcus

In 1900 Poynton and Paine obtained from the blood and inflammatory lesions of both surviving and fatal cases of acute rheumatism a diplo-streptococcus which was ultimately classed as a non-haemolytic streptococcus of the *viridans* type. The streptococcal hypothesis of the causation of acute rheumatism, thus initiated, has outlived all its competitors and has formed the basis of nearly all research work on this subject for many years. The streptococcus recovered from acute rheumatic lesions cannot be distinguished by specific laboratory tests; and clinical evidence favours the view that the causal streptococcus is a normal inhabitant of the alimentary tract. The factors which cause such a saprophyte to become pathogenic are at present imperfectly understood. Possibly repeated mild infections, by wearing down resistance, pave the way to an acute attack; or the virulence of the streptococcus becomes exalted in its passage through the inflamed tonsils. More recently it has been suggested that an allergic factor is present, an acute attack developing in a patient already sensitized to the infection; or that throat infections by haemolytic streptococci in some way activate the non-haemolytic type; or that there is a coexistent virus infection (Schlesinger *et al.*, 1935; Eagles *et al.*, 1937). Although the virus hypothesis is as yet unproven, there seems no doubt that there is an element of truth in each of the other suggestions.

Allergic hypothesis

Virus hypothesis

In spite of the difficulties in connexion with the streptococcal hypothesis, it is impossible to set aside the evidence in its favour and the association between acute rheumatism and throat infections, which was recognized long before the term 'oral sepsis' was coined. Nothing seems clearer clinically than that acute rheumatism is not due merely to the fortuitous meeting of a particular germ and a child; other factors are of vital importance. The explanation of the part played by them must not only take into account the problems already mentioned but also explain why the histopathology of rheumatic infection is so unlike that found in other streptococcal lesions.

Morbid anatomy

The rheumatic infection sets up in the infected tissue a characteristic proliferative reaction. The gross lesions can be seen in the subcutaneous nodes of the disease during life and in the 'beads' on the valves of the heart after death. For the histopathology of rheumatic infection see the article HEART DISEASES: RHEUMATIC HEART DISEASE IN CHILDREN, Vol. VI, p. 237.

4.–CLINICAL PICTURE

Modifications according to age

Juvenile type

There are important differences between juvenile rheumatism and the disease in adults. The adult type begins to appear after the age of 12 years. In children the rheumatic infection, like other infections in early life, tends to become generalized: arthritis plays only a subsidiary part in the symptomatology, and the heart and brain bear the brunt of the infection; subcutaneous nodes are relatively common; the temperature, in the absence of acute tonsillitis or pericarditis, rarely rises above 102° F., but a low fever tends to be prolonged owing to persistence of the infection in the heart or tonsils; convalescence may therefore be slow and subject to relapses. In the adult type arthritis is prominent, and the heart and brain tend to be relatively spared; the

Adult type

temperature reaches 103° to 104° F. but under treatment tends to fall quickly to normal, and convalescence is rapidly established. On the other hand, in both children and adults with established heart disease fresh carditis may arise with little evidence of other rheumatic manifestations.

Prodromal symptoms

In adults an acute attack usually develops rapidly with only slight warning symptoms; but in children these are usually present for some weeks or months before severe symptoms appear. This prodromal stage is best appreciated by studying the analogous condition of the rheumatic child between acute phases. The child who is developing rheumatism is always physically subnormal, and its symptoms may be grouped under the following four heads: (i) constitutional symptoms of debility, fatigue, epistaxis, pallor, loss of appetite, and shortness of breath; (ii) sore throat followed by muscular pains in the limbs and trunk; (iii) nervous symptoms of headaches, emotionalism, insomnia, and fidgetiness, with possible functional disorders, such as tics, sleep-walking, and enuresis; and (iv) signs of cardiac involvement, including tachycardia.

Invasion symptoms

Tonsillitis

The onset of acute symptoms usually follows 7 to 21 days after a sore throat or 2 or 3 days after a chill or exposure to cold. The temperature rises rapidly, and the disease declares itself. Tonsillitis is associated with rheumatic infection in three ways. (i) As a presumably genuine rheumatic condition, it arises spontaneously or in connexion with some mild chill, and is followed after an interval of 7 to 21 days by an attack of acute rheumatism. Of the same type are the attacks of tonsillitis, with evanescent fever, that so commonly interrupt the course of convalescence in a rheumatic child. Tonsillectomy exerts an effective influence in reducing the frequency of these spontaneous sore throats. (ii) The sore throat arises in connexion with some contagious or epidemic nasopharyngeal infection and may be followed by acute rheumatism after a silent period. In these cases the haemolytic streptococcus plays a predominant part, as in epidemic catarrhs, 'influenzal' colds and epidemic sore throats, scarlatina, diphtheria, and measles. This type of sore throat will attack the lateral pharyngeal walls in tonsillectomized children fairly readily. (iii) The third type is the chronic tonsillitis, with usually small septic tonsils showing their persistent infection by the reddening of the faucial pillars and the enlargement of the tonsillar glands in the neck. There is no way by which a rheumatic throat can be recognized as such by inspection, nor are bacteriological examinations convincing.

Fibrositis

In juvenile rheumatism muscular and fibrositic pains largely take the place of the arthritis of the adult type. They may be short and sharp pains or more prolonged aches; they tend to be made worse by exercise and better by rest and to be accompanied by a slight rise of temperature. They are worse in cold and wet weather. They occur about the joints of the limbs, especially behind the knees. Rheumatic pains in the neck (rheumatic torticollis) are frequent and characteristic. They also occur in the sides and epigastrium.

Arthritis In the adult type of acute rheumatism acute arthritis, accompanied by a temperature of 103° to 104° F., dominates the picture. With the development of synovitis and periarthritis the affected joint becomes red and swollen. Its chief characteristic is the excruciating pain produced by the slightest movement or jarring of the joint. It is not particularly tender to gentle palpation, so long as the joint is not moved. The lymphatic glands draining the joint are not enlarged. Unless adequately treated, the arthritis tends to spread from one joint to another, the first subsiding as the next develops. With effective treatment the development of fresh arthritis is quickly stopped, and the signs of active inflammation subside. A residual collection of fluid and some discomfort may remain in a quiescent joint for a week or so.

Pyrexia In juvenile rheumatism, in the absence of acute tonsillitis or pericarditis, the temperature rarely rises as high as 103° F. On the other hand, owing to the frequent involvement of the heart, the fever tends to be protracted, with a regular rise of the nocturnal temperature to 99·5° or 100° F. The convalescence of a rheumatic child is important and has been studied under HEART DISEASES: RHEUMATIC HEART DISEASE IN CHILDREN (see Vol. VI, p. 252). In uncomplicated chorea the temperature is often below normal throughout, the evening readings being a degree or more higher than the morning. In rheumatism of the adult type with polyarthritis (the old-fashioned 'rheumatic fever') the temperature rises to 103·5° or 104° F. but quickly subsides. Under effective treatment the temperature should touch, but not be maintained at, the normal on the third day and be practically normal by the end of a week. *Hyperpyrexia* Rheumatic hyperpyrexia has now virtually disappeared. When it occurred it was almost always associated with acute pericarditis and was at one time usually fatal. It was always much commoner in adults than in children, presumably because a child could not survive such a severe infection long enough to develop hyperpyrexia.

Nervous symptoms Headache due to rheumatic toxaemia is common in the prodromal and invasion stages of juvenile rheumatism. Acute rheumatic meningitis was formerly described, but its occurrence is doubtful. Active rheumatic infection always upsets the nervous system of a child, and, apart from the development of obvious chorea, signs of nervous disorder can always be traced (latent chorea). Those seen in the prodromal stages of the infection have already been mentioned (see p. 643), and in the acute phases of the disease emotionalism, fidgetiness, and excitability are part of the clinical picture.

Chorea Chorea as a fully developed disorder is described under that title (see *Heart disease* Vol. III, p. 204). Rheumatic carditis and its effects have been described in Vol. VI, p. 237.

Nodules The term nodule is used to express three sets of lesions in rheumatic infection: (i) the subcutaneous nodules ('nodes'); (ii) the minute nodules palpable in muscles and fasciae (V. Coates's 'granules'); and (iii) Aschoff's submiliary nodules, microscopical lesions. These are all the result of the proliferative tissue-reaction set up by the rheumatic infective agent and so are strictly comparable to the endocardial vegetations ('beads') found on the valves in rheumatic carditis.

Subcutaneous nodes

Subcutaneous nodes are commoner and more significant in children than in adults. In their acute form they are soft painless movable little lumps occurring with extraordinary symmetry in the neighbourhood of joints and on tendons and fasciae. The commonest sites are the knees, elbows, and occipital ridges, but, when very numerous, they occur over the vertebral spines, iliac crests, spines of the scapulae, and knuckles. At first they are soft and composed of fibrinous material but, if they are not absorbed in three or four weeks, they become harder and more fibrous and then may remain for many months. In severe cases some haemorrhage may be seen round the nodules. Subcutaneous nodes are, then, visible results of rheumatic infection analogous to the endocardial vegetations in rheumatic endocarditis and consequently of great clinical significance. In typical form and distribution they are pathognomonic of rheumatic infection; their presence denotes a severe form of rheumatism, and consequently they are almost invariably associated with heart disease. Their appearance connotes, with some exceptions, the onset of fresh carditis, and their disappearance is a favourable sign. Lastly, very numerous rheumatic nodes—they may number 200 to 300 at one time—make the outlook extremely grave, though even in such numbers they are no longer the 'death sentence' that they were in W. B. Cheadle's time.

Blood changes

Acute rheumatic infection in any form rapidly produces a hypochromic anaemia which persists until the infection has completely subsided. In acute phases there is a mild leucocytosis, followed during convalescence by a relative lymphocytosis and later by eosinophilia. These changes in the blood are not sufficiently clear-cut to afford an accurate test for the complete disappearance of infective activity.

Haemorrhages

Haemorrhages in rheumatism are rare and confined to severe types of infection. They may occur into affected joints or the pericardium and round the subcutaneous nodes.

Albuminuria

Albuminuria is common in the invasion stage of juvenile rheumatism, but acute rheumatic nephritis is rare.

Skin manifestations

The drenching acid sweats, so characteristic of the old-time cases of 'rheumatic fever', are now rare, but the adult with polyarthritis sweats fairly freely. In children the hands and feet are perpetually damp, but perspiration elsewhere, as on the forehead, is rare.

Erythema marginatum

The only true rheumatic rash is the diffuse erythema which, from its crescentic edges, is called erythema marginatum. It is bright pink and may appear in large areas on the trunk and limbs, fading in a day or so. It is the most truly allergic of all rheumatic manifestations, and its appearance or disappearance seems to have little to do with the activity or subsidence of the general rheumatic infection and thus is of no great clinical significance. Erythema nodosum and peliosis rheumatica, in spite of the sore throats and arthralgia with which they may be associated, are not true rheumatic manifestations.

Pulmonary symptoms

Extension of pericarditis to the pleura, usually on the left side, is not uncommon. Such pleurisy is probably a truly rheumatic manifestation.

Rarer manifestations

Acute rheumatic bursitis, in association with arthritis, is an occasional occurrence. Thyroiditis has been described. Acute appendicitis may complicate acute rheumatism in the same way as it may follow other throat infections. A local peritonitis may develop as an extension of pericarditis. 'Rheumatic iritis' is not a manifestation of acute rheumatic infection.

Offset and convalescence

In children a rheumatic attack tends to pass off slowly and convalescence to be prolonged and possibly interrupted by relapses. This is due to the involvement of the heart and perhaps in part to septic tonsils. Convalescence in a tonsillectomized rheumatic child is smoother and quicker than in one with chronic tonsillar infection. A rheumatic attack is not properly over in a child until colour and weight have been regained and the sleeping pulse-rate has returned to normal. In adults, in whom the heart tends to be spared, convalescence is established with comparative rapidity and ease.

5.–COURSE AND PROGNOSIS

Course

The differences in the course of acute rheumatism in children and in adults have already been mentioned (see p. 643); the factors which tend to prolong a rheumatic attack are those characteristic of the juvenile type of the disease, namely, carditis, chorea, subcutaneous nodules, and chronic tonsillar infection.

Prognosis

In acute rheumatic infection at any age the prognosis as regards life, immediate and ultimate, depends on the degree of involvement of the heart, and this in turn depends on the severity of the infective process. Juvenile rheumatism must be regarded as severe if it occurs in a child under 7 years of age; if it produces high fever, pericarditis, or multiple nodes; or if the heart has already been severely damaged in previous attacks. On the other hand, the heart tends to be spared in primary attacks in children over 12 years of age; in tonsillectomized children and those with healthy tonsils; and in those who have already passed through one or two attacks without obvious damage to the heart.

Deaths

Death in a first attack of rheumatism is rare even in children but may occur in those under the age of 7 years. The total death-rate under the age of 12 is small; even the cardiac cripple of childhood usually survives into the teens; and the great majority of patients with rheumatic heart disease contracted in childhood survive to adult life, but the death-rate in early middle-age is heavy.

Reinfections

The tendency in juvenile rheumatism towards repeated reinfections vitiates all attempts at accurate prognosis. In rheumatic children of the poorer classes it can only be said that no assured immunity develops under the age of established puberty. In the exceptional instances of rheumatism in well-to-do children reinfections are rare.

Adults

In adults primary attacks of acute rheumatism occur with diminishing frequency up to early middle-age, and in these the heart tends to be spared as compared with first attacks in childhood; but large numbers of acute cases are seen in adolescents and young adults who have had their first attacks of carditis during childhood. Further, it must be remembered that in cases of long established rheumatic heart disease the factor which turns the scale against the patient and causes death is usually a fresh attack of active carditis rather than merely mechanical overstrain. If this is admitted the mortality from active rheumatic infection is indefinitely increased. Probably the total mortality in England and Wales from acute rheumatism and its results amounts to between 15,000 and 20,000 cases per annum. *Mortality*

6.–DIAGNOSIS

In children In children there is a danger of overlooking rheumatism in its early stages, but in its acute phases recognition is usually easy. *Pains* Muscular pains may be present in many physically subnormal children who suffer from toxaemia from the throat or bowel as well as in neurotic anxious children; and cases of non-rheumatic pains are probably relatively increasing as the frequency and severity of juvenile rheumatism diminish. Pains in the neck, producing torticollis, are generally rheumatic in the absence of inflamed glands; pains in the arms, wrists, and fingers are in favour of a diagnosis of rheumatism; pains in the legs alone are much more doubtful, but the rheumatic type can usually be recognized by the character of the pains and the general appearance and deportment of the child. The pains in the legs of the over-weight red-cheeked child should never be mistaken for rheumatism; no rheumatic child has such a physique. Persistent pains in the spine or hips may be mistaken for tuberculosis.

Arthritis Acute rheumatic arthritis rarely causes difficulties in diagnosis in children. The age incidence should differentiate it from syphilitic epiphysitis or scurvy, which are diseases of infancy. In acute poliomyelitis there is no swelling, and the degree of muscular weakness is out of proportion to the severity of the pain and fever. *Acute osteomyelitis* The recognition of acute osteomyelitis is by far the most critical point in the differential diagnosis of rheumatic arthritis in a child. In this disease the appearance of the child is quite different from that of the rheumatic child; he is severely ill and toxic with a normal heart; the pain remains fixed and may be accompanied by much tenderness; the fever and the leucocyte count are high; and later radiological changes develop at the site of the lesion.

In adults In adults the diagnosis of acute rheumatic arthritis is not as a rule difficult, especially if there is a history of the earlier involvement of other joints. In gonococcal arthritis, most typically seen in the feet, the patient is not so ill as in rheumatism, and the arthritis remains more localized to one joint, does more local damage, and fails to react to salicylate therapy. In acute gout there is severe pain even with the affected joint strictly at rest, and the extreme tenderness is very characteristic. The diagnosis of rheumatic heart disease and of chorea is discussed elsewhere (see Vol. VI, p. 249).

7.–TREATMENT

Preventive

Sociological

Supervision

The constant and definite class-incidence of juvenile rheumatism proves that the prevention of the disease on a large scale is to a great extent a sociological problem and a matter of raising the standard of living of the poor: better housing, less damp, more warmth, and better clothing and food. From the more strictly medical aspect the early diagnosis of juvenile rheumatism is of such prime importance that all children with suspected or definite rheumatism should be brought as early as possible under special methods of supervision and after-care.

Remedial

General measures

With any acute rheumatic manifestation accompanied by rise of temperature the patient should be kept in bed to quiet the heart's action, and given salicylate in some form to damp down the activity of the infection as effectively as possible.

The patient should be allowed to lie in whatever position is most comfortable. Blanket beds are hardly necessary unless sweating is profuse, but the weight of the bed-clothes should be taken off painful limbs. Inflamed joints may be wrapped in cotton-wool, but local applications involving the movement of the painful joints are not worth while. All jarring of the bed must be avoided in arthritic cases. A fluid diet should be ordered.

Salicylate therapy

Sodium salicylate

Aspirin

Salicylates provide an undoubted antirheumatic agent. The best results are obtained when the symptoms are due to acute rheumatic infection, as in acute tonsillitis, arthritis, and primary pericarditis. When the symptoms depend on toxic parenchymatous changes, as in the myocardium or brain, the drug is at a manifest disadvantage; and on quiescent lesions, such as chronic tonsillitis, residual joint effusions, and established valvular disease, it obviously can not have any action. With these limitations the drug is of great value. Sodium salicylate is quickly absorbed and excreted and is to some extent a gastric irritant; it should therefore be given in small frequently repeated doses, with an equal dose of sodium bicarbonate. Acetylsalicylic acid (aspirin) is rather more slowly absorbed and excreted. It should not be prescribed with alkalis but if desired the compound calcium acetylsalicylate may be given. The sedative action of aspirin makes it peculiarly suitable for the salicylate treatment of chorea.

Sodium salicylate and bicarbonate

In acute cases the sodium salicylate and bicarbonate mixture should not be given less frequently than every four hours, day and night. When a large daily dose is needed, it is better to give the mixture more frequently than to increase the amount given at each dose. Thus 8, 9, or 10 doses may be given in twenty-four hours; for 10 doses the hours are 2, 6, 8, and 10 a.m., 12 noon, and 2, 4, 6, 8, and 10 p.m. The effective daily amount of sodium salicylate for a child is from 60 to 120 grains and for an adult 60 to 150 grains. Children require relatively larger doses than adults; but a child will seldom tolerate more than 10, possibly 12, grains for each dose, whereas an adult will take 15 or even 20 grains for a dose. *Dosage*

Nausea and vomiting may be induced by salicylates. The chief factors in their production are too large an individual dose, too large a daily quantity, too long administration of big doses, and the presence of constipation; but the most important factor, as the vomiting induced may be definitely harmful in such conditions, is the presence of cardiac dilatation of any severe degree. When vomiting develops, the drug should be omitted for 12 to 36 hours and restarted in modified doses. A child should be encouraged to take the salicylate as prescribed, and in hospital practice there is seldom any difficulty in this connexion. *Treatment of nausea and vomiting*

Supervision and after-care

In juvenile rheumatism, either suspected or established, a good deal can be done by systematic supervision and after-care to ward off the dangers which threaten the child. The methods to be adopted consist, on the one hand, in periodic inspection, education of parents in matters of home and school hygiene, protection against damp and cold, and special care during convalescence from all catarrhal and throat infection; and, on the other hand, in special medical measures, such as the enucleation of septic tonsils and the administration of salicylate. This matter has been fully discussed under the title HEART DISEASES: RHEUMATIC HEART DISEASE IN CHILDREN (Vol. VI, p. 254).

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RHINITIS

See ALLERGY, Vol. I, p. 316; COLDS, Vol. III, p. 273; NOSE AND NASOPHARYNX DISEASES, Vol. IX, p. 256; *and* OZAENA, Vol. IX, p. 354

RHINOSCLEROMA

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Reference may also be made to the following titles:

NOSE AND NASOPHARYNX DISEASES
OZAENA

1.–DEFINITION

1381.] Rhinoscleroma or, better, scleroma, because the disease affects the nasopharynx, pharynx, larynx, trachea, and even the bronchial tubes as well as the nose, was first described and named by H. von Hebra in 1870, though recognized at least some thirty years earlier. The characteristic feature is a hard infiltration which progresses slowly and produces great deformity (see Fig. 75) and stenosis.

2.–AETIOLOGY

Although the disease has been known for many years, the aetiology still remains obscure and gives rise to controversy, but the principal

Geographical incidence

factors appear to be geographical rather than racial. Most of the cases are reported from the Ukraine, but the disease is observed also in many Russian provinces where it was unknown before 1914. According to Bélinoff the centre from which it disseminates is in the region of the Pripet, a tributary of the Dnieper, where the provinces of Galicia and Volhynia are situated, and from this source it has spread east and west. To the west it has reached Poland, Czechoslovakia, and Jugoslavia, where it is endemic. To the west it also occurs in Italy, Germany, Rumania, Hungary, and Switzerland, but the cases are much fewer in these countries. In Switzerland it occurs only in Martigny and d'Entremont in the canton du Valais, and the few cases are becoming still fewer. In Vienna it is now only seen in patients who come from a distance for advice and treatment, although formerly it was not rare, and the disease has disappeared in Austria with the exception of a few cases in Styria. Further west it does not occur. To the east the spread in Russia is causing some anxiety, although this increase may be more apparent than real and due to better diagnosis. It may be partly explained by some cases in former years having been regarded as syphilis, lupus, or tuberculosis.

Another similar but less important centre has been discovered by Snijders in the island of Sumatra, where he proved the existence of twenty-six cases. There is a third source in Guatemala and San Salvador in Central America and, it is believed, another in South Carolina in the United States of America, where a few cases have been observed in persons who have never left the country.

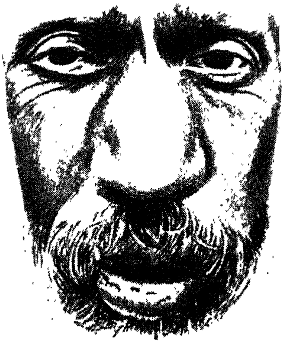

FIG. 75.—Rhinoscleroma: distension of nose by enormous multiple nodes. This and Fig. 76 from *Handbuch der Hals-, Nasen-, Ohrenheilkunde* by A. Denker and O. Kahler

Bélinoff explained this distribution and spread in a centrifugal direction from Galicia by the poverty of the district causing many of the inhabitants to emigrate temporarily to work in the neighbouring countries as market-gardeners. There is thus a continual fresh supply of subjects from the original source in Galicia.

Method of spread

It is still a matter of controversy whether the disease is infective or contagious. Familial contagion and contact with prisoners of war are held by some as a sufficient explanation, but the distribution of the cases in a diminishing number around the source in Galicia makes it appear that there is another unknown and mysterious factor which makes Galicia the centre of origin.

Sex incidence

Some statistics give the incidence of the disease as about equal between the two sexes; in others it appears to be commoner in women.

Age incidence It may begin at any age, but in half the cases in which the age is recorded it began between fifteen and thirty-five.

Occupational incidence It occurs almost exclusively among peasants and workmen, rarely in persons belonging to the leisured or professional classes.

Bacteriology The histological researches of Hebra and Kaposi led them to believe that the disease was neoplastic, but Mikulicz showed that it was inflammatory, and Frisch in 1882 isolated a diplo-bacillus from the nasal discharge. Cornil and Alvarez soon afterwards described fully the histological appearances and identified the bacillus of Frisch in the tissues.

Bacillus of Frisch This organism takes the form of short encapsulated rods, which can be cultivated on the ordinary media and produce raised white shining colonies giving off a disagreeable smell. The organisms are Gram-negative but in the tissues become Gram-positive. It is doubtful whether these organisms, which are identical morphologically with the bacterium found by Loewenberg in atrophic rhinitis and the pneumo-bacillus of Friedländer, are the specific organisms of the disease. Inoculation experiments in man and animals have failed to reproduce the disease, although Kraus believed that the organism was the causal agent and stated that he had produced the disease in mice by inoculation.

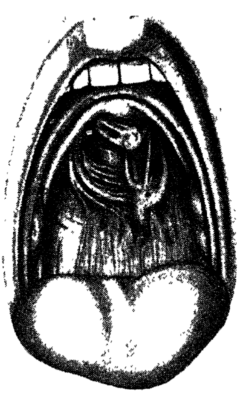

FIG. 76.—Rhinoscleroma: pharyngeal aspect. Two nodes on posterior wall of the pharynx; considerable formation of folds between them and the palatal arches, which, together with the uvula, have become adherent to the posterior wall of the pharynx

3.—MORBID ANATOMY

Histology In the early stage the tissues are infiltrated with lymphocytes, plasma cells, and polymorphonuclear leucocytes. Among these can be seen the large vacuolated cells of Mikulicz with an eccentric nucleus. *Mikulicz's cells* There are present also Russell's bodies, *Russell's bodies* large hyaline or colloid cells which stain deeply with fuchsine.

Later, fibroblasts and connective-tissue cells are seen in great abundance, with Mikulicz's cells, which are crammed with Frisch's bacilli. *Hyaline degeneration* The latter appear to produce a toxin causing hyaline degeneration and transforming the cells into Russell's bodies. The Mikulicz's cells, abundant in the earlier stages, disappear when a transformation takes place into fibrous tissue which undergoes hyaline degeneration. The blood-vessels also become obliterated from thickening of the walls and undergo hyaline degeneration. The epithelium on the surface also degenerates, but there is no tendency to ulceration.

4.–CLINICAL PICTURE

The disease begins insidiously, usually in the region of the upper lip *Onset* or alae nasi, with nasal discharge, sneezing, and epistaxis. Atrophy of the nasal mucosa and crusting may lead to an erroneous diagnosis of ozaena, but the sense of smell is not lost. Red flat nodules of cartilaginous hardness appear singly and in masses both in the skin and in the mucous membrane, and the appearance of the nose has been described as resembling the muzzle of an ox. A progressive stenosis is thus pro- *Extension* duced in the nasal fossae, the nasopharynx, and pharynx. The palate also may be affected with the nodules and, if the gums are attacked, the teeth become loose and fall out, and the alveolar processes atrophy.

In the larynx the anterior part or the base of the epiglottis is usually *Larynx* first affected by the nodules, but extension with contraction follows, and the stenosis may affect also the trachea and even the bronchioles. This stenosis is usually concentric in character but sometimes takes the form of bridges of fibrous tissue (see Fig. 76). Rare situations are in the eyelids and external auditory meatus, and the disease has been known to reach the middle ear along the Eustachian tube.

5.–COURSE AND PROGNOSIS

The disease is extremely chronic and compatible with good general health for long periods, until stenosis of the larynx and lower air-passages supervenes.

6.–DIAGNOSIS AND DIFFERENTIAL DIAGNOSIS

The diagnosis must be made from atrophic rhinitis in the early stage, and from syphilis, lupus, and leprosy. Agglutination and complement-fixation tests are indecisive, but bacteriological and histological examination of excised tissue give reliable information in cases of doubt. Owing to the limited distribution of the disease it is liable to be overlooked in countries where it is seldom seen, and it is most likely to be mistaken for late syphilis.

7.–TREATMENT

Radiotherapy both with X-rays and with radium has been reported *X-rays* to give relief in the early stages, but the later results have been disappointing. An autogenous vaccine has also been tried, and it has been *Vaccine* claimed that it can arrest the disease in its early stages (Cisler). Numerous drugs, including thiosinamine and chaulmoogra oil, have also been *Drugs*

Surgery

used. To combat the stenosis diathermy curettings and dilatations with bougies are required. Tracheotomy may be necessary to relieve the dyspnoea of laryngeal stenosis, and excisions followed by plastic operations have been attempted. Orlandini reported the successful removal by endoscopy of a subglottic mass in a woman of sixty, whereby the need for tracheotomy was averted.

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RHINOSPORIDIOSIS

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1.–DEFINITION

1382.] This name is given to an infection caused by a protozoon of the class Sporozoa and characterized by the occurrence of growths most commonly in the nose and more rarely in other parts of the body.

2.–HISTORY

Seeber of Buenos Aires in 1896 found in a nasal growth a parasite which in 1903 was described by Wernicke as *Coccidium seeberia.* In 1894 O'Kinealy removed a nasal growth, which he reported in 1903, with a pathological account by Vaughan. Minchin and Fantham examined sections of O'Kinealy's case and in 1905 published a full account of the organism as the *Rhinosporidium kinealyi.* The organisms in these two cases, from the Argentine and India, were similar in all respects. On account of priority in description the parasite is now generally known as *Rhinosporidium seeberi.*

3.–AETIOLOGY

Mycology The organism, which is not a coccidium as Wernicke originally thought, was classified by Minchin and Fantham as a protozoon in the class Sporozoa and placed in the sub-class Neosporidia, but its position in the sub-class was left undecided, because it presented some points of resemblance both to the Microsporidia and to the Haplosporidia. According to Castellani and Chalmers it belonged to the Sarcosporidia and the sub-class Neosporidia; J. H. Ashworth and Logan Turner suggested that the nearest relations of *Rhinosporidium kinealyi* were not the Sporozoa but the lower fungi (Phycomycetes), such as the Chytridineae, in which sub-order they provisionally placed it.

Geographical distribution Isolated cases have been reported from various parts of the world. Most of the cases occur in the Madras Presidency, especially on its west coast, where Cherian has seen a yearly average of 20 cases. A. J. Noronha (1933) reported several cases among sand workers in Poona (Bombay Presidency), and Allen and Dave (1936) reported a series of 60 cases seen in eighteen months in the districts of Drug and Raipur (Central Provinces). The remaining Indian cases appear to occur in Bengal, the Medical College Hospital, Calcutta, having had 31 cases in the period 1925 to 1938. The disease has not been reported from the University towns of Bombay, Lahore, and Lucknow. O'Kinealy's original case was in a native of Bihar. Seeber's cases were from the Argentine. J. H. Wright reported an isolated case in a farmer living in Memphis, Tennessee. Cases have also been recorded from Ceylon by Chelliah and by Castellani. Orosa and Manalang have reported cases from the Philippine Islands, and V. Denti reported the first European case in Lombardy in 1925.

In animals Zschokke (1913) and Quinlan and de Kock (1927) described nasal growths in the lower animals in South Africa, the first-named in a horse and the latter in two mules, the growths all containing a parasite allied to *Rhinosporidium* in man. Ayyar recorded three cases of nasal growths among cattle in Madras, with cysts identical with those in the human infection. Cordero and Vogelsang reported the infection in a horse in Uruguay. Laveran and Pettit and Plehn and Mulsow have reported morbid conditions in the salmon and trout caused by the *Ichthyosporidium*, an organism which closely resembles the *Rhinosporidium*.

Site of infection The nose is most often attacked, the commonest sites in order of frequency being the anterior and upper portions of the cartilaginous septum, the anterior end of the inferior concha (turbinate), the middle concha, and the floor of the nose; anterior positions in the nose are commonest, posterior ones rare. Tirumurti reported growths in the posterior nares and nasopharynx, into which they may hang down through the choanal apertures; other rare sites are the uvula, the posterior pillars of the fauces and the larynx. Nasal growths are confined to the mucosa, and even in the extreme case described by Logan Turner and Ashworth the sinuses escaped. Ingram described a smooth papillomatous cauliflower-like growth containing *Rhinosporidium* situated on the glans penis and apparently growing from the urethra. Growths have been recorded from both the palpebral and bulbar conjunctivae and from the lacrimal sac by Kirkpatrick, by R. E. Wright, and by Elliot and Ingram. Beattie found the same organism in aural polypi sent from Madras. Allen and Dave reported involvement of the skin in 2 of their 60 cases.

Sex incidence

The disease occurs at almost all ages, but most often in young males. Until 1936 only 4 cases had been recorded in females. In that year Allen and Dave reported 15 female cases in their series of 60, a ratio of 1 to 3. This remarkable sex incidence has not been explained. Occupation does not appear to be an aetiological feature. Most cases in India are in ill-nourished people whose standards of living are low.

4.–MORBID ANATOMY

Microscopical appearance

Microscopically the growth appears to be a reaction on the part of the submucous or sub-epithelial tissues, resulting in their overgrowth, in response to the presence of the parasite. Underneath an epithelial covering, varying in character according to the site from which the growth arises, is a vascular stroma with newly formed blood-vessels. In places the stroma is myxomatous, in others fibro-cellular or cellular, young connective-tissue cells, lymphocytes, and polymorphonuclear leucocytes predominating. Areas of haemorrhage are common; collections of free spores and spore morulae and active phagocytosis are visible. Packed in great abundance in this stroma are cysts of various sizes showing the parasite in all stages of development. At first the cysts are small and contain undifferentiated granular protoplasm; later they enlarge, and the protoplasm becomes segmented; others contain fully formed spore morulae and spores; others have burst at one point and liberated free spores into the submucous tissues; these spores ultimately find their way, through deficiencies in the mucous membrane, to the mucoid discharge of the nose, in which they are always present in large numbers.

Method of infection

Attempts to grow the parasite outside the human body have failed, inoculation experiments in the lower animals have been unsuccessful, and investigations to solve the manner of the spread of the disease from man to man have been fruitless. As, however, a number of cases occur in the same districts and villages, it may reasonably be supposed that infection from man to man takes place, probably through the medium of the air. The presence of the disease in horses, mules, and cattle and a morbid condition in fish caused by *Ichthyosporidium*, an organism allied to *Rhinosporidium*, suggest the possibility that the lower animals may act as reservoirs from which the disease spreads to man by air or water. Previous trauma of the nose appears to favour the implantation and growth of the organisms in that situation.

5.–CLINICAL PICTURE

The growths

Signs and symptoms vary with the site of the disease. In the nose the development of the parasite in the submucosa leads to the formation of a very characteristic growth, which is nearly always pedunculated, single, and reddish-blue or dark pink. The growth consists of tightly packed feathery fascicles resembling the branching of a cauliflower, and the shiny velvety surface is studded with whitish spots, denoting on the surface the position of the cystic formations seen microscopically underneath the mucous membrane. This spotted appearance led the early observers to describe the growth variously as a raspberry or strawberry. The growths are freely movable, are so soft and fragile as to tear on being lightly grasped with forceps, and bleed easily and profusely. Multiple growths are comparatively rare, and small sessile formations have also been described. The affected side of the nose is bathed in a mucoid secretion. Growths in more exposed positions of the body other than the nose, e.g. the penis, have the same polypoid cauliflower-like appearance as in the nose but are smooth on the surface from the presence of an epithelial covering. On the conjunctiva the growths form small pedunculated dark-red fleshy vascular masses. When very small, before the formation of a pedicle, they only project slightly and show the same white spots as in the nose.

Symptoms

Nasal obstruction, epistaxis, and a mucous discharge are the main symptoms. The larger the growth the greater is the obstruction, and the more anterior the position the more the bleeding, owing to the greater liability of growths in this situation to minor injuries. The continuous mucous discharge is a most distressing symptom. Sneezing was prominent in one of my cases with a growth on the middle concha (turbinate).

6.–DIAGNOSIS

The growths in the nose are so typical and unlike anything else that their recognition should be easy. Microscopical examination of the mucoid discharge from the nose will reveal the spores in abundance, and sections will show parasitic cysts.

7.–TREATMENT

Microscopical sections show that there is no deep penetration or infiltration and that the growths are the result of a tissue reaction in the submucous and sub-epithelial layers. In the early stages therefore, when the growths are single and small, their complete eradication is not difficult. In most cases in the nose the growths are single, pedunculated more often than sessile, and situated in an anterior and therefore accessible position.

Small pedunculated growths

The simplest way to deal with these small pedunculated growths is to remove them under a local anaesthetic with a nasal snare as close as possible to the base, which is then carefully destroyed with a cautery at a dull red heat. As bleeding is always severe whenever these growths are handled, special care should be taken to secure good haemostasis by completely surrounding the growth and pedicle and covering adjacent parts of the mucous membrane with cotton-wool soaked in a solution made up of equal parts of adrenaline hydrochloride solution (1 in 1,000) and 10 per cent cocaine hydrochloride solution, and leaving this in contact for at least three-quarters of an hour.

The incidence of recurrences depends upon two important points in technique, (i) careful destruction of the base of the growth, and (ii) avoidance of trauma to adjacent surfaces of mucous membrane upon which free spores present in the nose may be implanted and start new growths.

Sessile and semi-pedunculated growths

Sessile and semi-pedunculated growths should be excised with a portion of healthy tissue. Some surgeons indeed advocate excision with a margin of healthy tissue as a method of choice in every case.

Inaccessible and extensive growths

A problem always arises when the growths are far back, when they are multiple, and when large surfaces of mucous membrane are involved. Their removal in these circumstances may become formidable and difficult owing to haemorrhage, which is characteristic of this growth and for which special measures are nearly always necessary. Cherian has reported the splitting of the soft palate in order to remove a postnasal growth satisfactorily. Logan Turner has had to perform a Rouge operation with a wide resection of the septum in order to eradicate the disease completely in a case of his, and Allen and Dave reported the performance of a laryngo-fissure to deal with a growth situated at the entrance of the larynx.

Electrotherapy

The electric cautery is a useful adjunct in all these large operations for the successful destruction of infected tissues. Electrolysis with a zinc needle and diathermy are also recommended as methods of treatment.

Chemotherapy

A search is being made for some chemical substance to kill the parasite in the tissues, and in this connexion Allen and Dave have in their more serious cases tried the intravenous injection of 2 to 4 grams of neostibosan (Bayer) in 0·3 gram doses with some measure of success.

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RICKETS

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Reference may also be made to the following titles:

ANTENATAL CARE
COELIAC DISEASE
DENTITION
DIETETIC DEFICIENCY DISEASES
DWARFISM AND INFANTILISM
INFANT FEEDING
PARATHYROID GLAND DISEASES

I.—RICKETS

1.–DEFINITION AND CLASSIFICATION

(*Synonyms.*—Rachitis; English disease)

Definition

1383.] This is a disorder of calcium and phosphorus metabolism due, in most instances, to a lack of vitamin D in the diet and to inadequate exposure to sunlight, and affecting primarily the skeletal calcification. Although a potentially rachitic state may exist during periods of arrested growth, the disease is essentially one of active growth, and its most characteristic manifestations are seen during the rapid development in infancy.

Classification

Cases of true 'deficiency' rickets may be classified according to the age at which the disease appears.

Foetal rickets

(i) Very rarely, a true rachitic condition is observed at birth in the infants of women suffering from osteomalacia or of women who have been on a grossly deficient diet during pregnancy. The rarity of the condition is due to the fact that in a state of calcium-deficiency the foetal skeleton tends to grow at the expense of the mother's. True foetal rickets must be sharply distinguished from osteogenesis imperfecta (see Vol. II, p. 554) and achondroplasia, with both of which it was confused in the earlier literature.

Infantile rickets

(ii) The common type of rickets is seen in infants between the ages of four months and two years, but it may occur earlier, e.g. in premature babies, and continue after this age-period.

Late rickets

(iii) The terms late rickets and juvenile osteomalacia are now frequently used synonymously (Wilson), though some authors (Roehm) have distinguished a type of juvenile osteomalacia on the basis of its resistance to treatment by vitamin D and ultra-violet rays. Some cases of late rickets represent a persistence of infantile rickets, particularly in negro children removed to a northern climate; in others the condition appears to have arisen during later childhood.

Most workers agree that osteomalacia of adults, which occurs particularly among Eastern women on a deficient ill-balanced diet and during famine conditions ('hunger osteomalacia'), represents essentially the same condition in a later age-group.

Coeliac rickets

In addition, three special types of rickets associated with disease elsewhere have been recognized. (i) The failure of fat-absorption which characterizes coeliac disease is liable to lead not only to vitamin D deficiency but also to an excessive loss of calcium in combination with fatty acids in the stools. The associated arrest of growth often delays the manifestations of the rachitic state until later childhood. The condition can be prevented and cured by the administration of vitamin D concentrates and ultra-violet rays and does not differ essentially from other types of deficiency rickets, except that it is usually of low-calcium rather than of low-phosphorus type. (ii) A type of late rickets associated with renal deficiency has been recognized since 1911. The pathology is in so many respects peculiar that the condition will be considered separately (see p. 672). (iii) An extremely rare and severe form of rickets has been described as secondary to long-standing hepatic disease. Gerstenberger's three cases had hepatic cirrhosis with, in two instances, atresia of the bile-ducts. They were all characterized by hypophosphataemia and resistance to treatment.

Renal rickets

Hepatic rickets

Scurvy-rickets

So-called scurvy-rickets should not be regarded as a distinct type of rickets but as the association of scurvy and rickets in the same patient.

2.–AETIOLOGY

The great volume of experimental and clinical work carried out on rickets since the War 1914–18 and pioneer studies (Edward Mellanby; Paton, Findlay, and Watson, and others) make it clear that rickets can be prevented and cured either by an adequate intake of vitamin D or by exposure to ultra-violet rays, unless the diet is very grossly defective (see p. 664). The great majority of clinical patients have had an inadequate supply of fat-soluble vitamin D and have also been subjected to a regime in which exposure to sunlight has been minimal, since ultra-violet rays are probably responsible for the intrinsic production of vitamin D by photosynthesis in the skin.

Exposure to ultra-violet rays

It has been shown by Hess (1922) and others that the rays with a wave-length of 2,800 Ångstrom units are those most effective in the prevention of rickets, and that the range of effective wave-lengths lies between 2,600 and 3,150 Å. Park and Eliot pointed out that, owing to the effect of the atmosphere in filtering out rays at this end of the spectrum, there would be, outside the equatorial zone, a seasonal variation due to the obliquity of the rays, resulting in a dearth of these rays during the winter months and a maximal supply at the summer solstice. Similarly the dust and smoke of cities filters off many of these rays, so that a child living in London or Glasgow is in considerably greater danger of developing rickets than one whose home is in the country. There is also a higher proportion of antirachitic rays at higher altitudes. The value of 'sky-shine' in providing such rays is less accurately known, but it appears to be an important source in areas where there is little direct sunshine.

Seasonal incidence

This seasonal variation in the supply of antirachitic rays is closely reflected in the incidence of rickets, which shows a peak in March and early April, following the darkest months of the year. It also results in the seasonal tide of inorganic phosphorus in the blood of normal infants, which Hess and Lundagen found to fall from an average value of 4·35 mgm. per 100 c.c. in June and July to 3·92 mgm. per 100 c.c. in December, the fall continuing through January, February, and March. The effect of exposure to ultra-violet rays is probably not directly proportional to the surface area of body exposed, and there is no doubt that the regular exposure of small areas, e.g. face, hands, and legs, may be quite effective in preventing rickets. The penetration of clothing by the ultra-violet rays depends on the texture and thickness; white materials allow greater penetration than black.

Diet

It has been abundantly proved that the addition of antirachitic substances, e.g. halibut- and cod-liver oil, irradiated ergosterol, and other irradiated foods, to the diet both prevents and cures rickets. Yolk of egg has some antirachitic value, but this shows great seasonal variation, and either cows' or human milk alone often proves an insufficient protection. Diets low in calcium and phosphorus are rachitogenic, and a disproportionately high carbohydrate content tends to have a similar effect. The exact part played by vitamin D, whether obtained directly in the diet or produced by exposure to ultra-violet rays, is by no means clear. It increases the absorption of calcium and phosphorus from the intestine and indirectly regulates the normal calcification of bone.

Vitamin D

Climate

The paucity of antirachitic rays in northern climates leads to the greater danger of rickets, unless a compensatory amount of vitamin D is taken in the diet. Conversely, rickets is rare in climates with a high annual incidence of sunshine. Although the incidence of infantile rickets in India has probably been under-estimated, it is significant that the children of many osteomalacic women living in purdah escape rickets, because they are commonly exposed freely to the sun until puberty.

Race

All races are liable to rickets if exposed to conditions which produce it. Some of the most severe cases are seen in children of heavily pigmented races, such as negroes, who have been removed from tropical climates to North America. Their pigmentation, which would normally protect against excess of sunlight, prevents them from benefiting from the small quota of antirachitic rays penetrating the atmosphere of their adopted country. The high incidence of rickets in England and the classical description given by Glisson led to the condition being known as 'the English disease'. Rickets became still commoner during the nineteenth century owing to the popularity of artificial feeding and the concentration of the population into crowded industrial areas.

Age and growth

Rickets being essentially a disease of active growth, marasmic infants, in whom growth is arrested, are unlikely to manifest it, whereas rapidly growing infants between four months and two years of age are much more liable to do so. The less limited diet and exposure to sunlight of older children make rickets exceptional after early childhood, unless some complicating factor is present.

Infection

Not only does the rachitic state predispose to infection, but infection, particularly if long-standing, often precipitates or adds to the severity of rickets. This is well seen in congenital syphilis, affected infants being subject to severe rickets.

Idiosyncrasy

In institutions, where all infants receive similar care and diet, some may develop rickets whereas others appear more resistant. Premature babies are so liable to it that the milder degrees of rickets have been regarded as almost physiological in such cases. It was commonly supposed that the premature infant was born with a smaller supply of antirachitic factor in the liver than was the full-term baby, but the assays of premature and full-term livers by Hess and Weinstock did not bear this out. Mai's recent study of the 'intrinsic radiation' of the blood in rachitic and non-rachitic infants may possibly throw some light on the factor of idiosyncrasy, which is not as yet satisfactorily explained.

Mental defect

Mental defect may be regarded as a predisposing cause of rickets, since mentally defective infants frequently do not obtain the requisite diet, fresh air, light, and exercise during later infancy. There is no convincing evidence that rickets produces mental defect; the occasional association with true hydrocephalus is probably accidental.

3.–PATHOGENESIS AND MORBID ANATOMY

(1)—Metabolism

Serum calcium

Blood-phosphorus

Ca × P product

Vitamin D is thought to increase the absorption of calcium and phosphorus from the intestines. Although in most cases of uncomplicated rickets the total serum calcium does not fall below the lower limits of normal, it is probably maintained at this level by the parathyroids, which mobilize calcium at the expense of the bones (see p. 666). The total blood-phosphorus, however, is commonly considerably reduced. It was formerly thought that the rachitic derangement of ossification was due to a simple reduction of the Ca × P product; Howland and Kramer suggested that the product of the serum calcium and phosphorus expressed in milligrams per 100 c.c. was a useful index of the presence or absence of rickets. Thus a product of 40 or over was taken to negative the presence of rickets and of 30 or below to indicate active rickets. Although this empirical formula holds good in many cases, it is by no means absolutely reliable; recent work indicates that the deposition of calcium phosphate in the bones is not a simple process of precipitation. Indeed, Benjamin and Hess considered that both calcium and phosphorus existed in at least two forms in the blood; they found that in rickets the principal defect lay in the adsorbable calcium-phosphorus complex, and that in the low-phosphorus type of rickets in infants a disturbance of calcium partition occurred. There is thus no evidence that vitamin D has a direct action on ossification; but, when vitamin D is deficient, the composition of the tissue fluids becomes deranged owing to the failure of calcium and phosphorus retention, and defective ossification, with the characteristic changes of rickets, results.

Action of vitamin D

Plasma phosphatase

Although it is seldom practicable to make complete estimations of calcium and phosphorus retention in infants, a more delicate index of the rachitic state than is given by the inorganic blood-phosphorus is afforded by estimation of the plasma phosphatase, which rises in active rickets and falls when healing occurs. Morris and his co-workers found the average value of plasma phosphatase in healthy infants during the first two years of life to be 6·92 units and regarded values over 11 as abnormally high. A high plasma-phosphatase occurs with vitamin D deficiency but does not necessarily indicate such deficiency; thus a high plasma phosphatase is present in osteitis fibrosa, osteitis deformans, and other diseases of bone. It probably results from increased activity of the phosphatase-producing cells of the osseous system; normally the phosphatase produced would be utilized in ossification; but, when this is defective owing to lack of calcium and phosphorus retention, the phosphatase produced remains in excessive amount in the blood. Administration of vitamin D in rickets causes the plasma phosphatase to fall.

(2)—Endocrine Glands

Parathyroids

It has been repeatedly observed that the parathyroids have hypertrophied both in rickets and in osteomalacia. Since the metabolism of calcium not only affects ossification but largely controls muscular irritability, any tendency for the serum calcium to fall is to some extent compensated by an increased output of parathyroid hormone, which acts in a different way from vitamin D, maintaining the serum calcium not by increased absorption from the intestines but by mobilization of calcium from the bones. Although such action tends to prevent tetany, it makes the rachitic condition worse by inducing generalized osteoporosis. In some cases in which this mechanism is not effective or the osseous system has been excessively depleted the serum calcium falls, and tetany occurs as a complication of rickets or of osteomalacia.

(3)—Morbid Anatomy and Histology

The characteristic changes are seen in the skeleton and consist of (i) osteoporosis and softening of the bones, resulting in craniotabes and deformities of the thorax and limbs (see p. 667), and (ii) irregular proliferation and defective ossification of the epiphysial cartilage columns, resulting in epiphysial enlargement and beading of the ribs. The parathyroid glands are also hypertrophied (see above). Fatty infiltration or enlargement of the liver, enlargement of the spleen due to coincident nutritional anaemia, and morbid changes in the lungs or intestines due to bronchitis or gastro-enteritis respectively may be seen at necropsy but are not strictly speaking rachitic. Cardiac enlargement has also been described.

Histology

Microscopically, the epiphysial cartilage columns, which are normally compact and clearly aligned, are very irregular, and the normal zones between cartilage and bone become unrecognizable. In active rickets the cartilage cells continue to proliferate but, owing to the changed condition of the blood serum, are not converted into normal bone. Cartilage cells at various stages of maturity therefore accumulate at the end of the shaft. The capillary loops, which normally advance regularly and uniformly, penetrate irregularly and extensively into the area of

Cartilage cells

Capillary loops

cartilage cells, their penetration being determined by the sites of defective calcification of the matrix due to the altered composition of the blood plasma. Calcification is defective also where osteoid tissue is being formed and, since osteoblastic activity continues, an increased amount of uncalcified osteoid tissue is produced. There is therefore an abnormally wide zone of proliferative cartilage penetrated by 'bushes' of vessels from the shaft, surrounded by osteoid tissue. The total vascularity of the area is considerably increased.

Osteoid tissue

Shafts of long bones

Frontal and parietal bosses

The shafts of the long bones show, in addition to generalized osteoporosis, an increased deposition of soft spongy bone below the highly vascular periosteum. A similar deposition occurs over the frontal and parietal bones, causing the characteristic bossing.

4.–CLINICAL PICTURE

This depends to some extent on the age at onset, and the skeletal deformities depend on the principal sites of pressure. Thus a young infant lying on its back is more likely to suffer from craniotabes, and one who has begun to walk from bending of the legs or pelvis. Although the essential rachitic changes are found in the bones, the muscular, respiratory, and gastro-intestinal systems are often affected.

Skeletal system

'Rickety rosary'

Harrison's sulcus and pigeon breast

Depression of sternum

One of the cardinal signs is beading of the ribs, due to enlargement of the costochondral junctions and causing the 'rickety rosary'. The nodular swelling affects both the costal cartilage and the rib and thus differs from the beading often seen in infantile scurvy, in which a sharp line of demarcation may sometimes be felt between the expanded end of the rib and the sunken costal cartilage. The thorax commonly shows some degree of deformity, from a slight flaring outwards of the lower ribs to a deep horizontal groove (Harrison's sulcus) below the nipples (see Fig. 77) or a vertical depression on either side of the sternum causing 'pigeon breast'. In other cases the sternum may be depressed, but the true *Trichterbrust* (funnel sternum) is usually a congenital and often familial deformity not related to rickets. Thoracic deformities are particularly severe in infants who have suffered from repeated respiratory infections and in those in whom the spine is also affected.

Cranial bossing

Facies

Anterior fontanelle

Bossing of the skull (see Fig. 77) is seen over the frontal and to a lesser extent over the parietal bones, causing the characteristic bulging brow, square skull, and flattened facies. The anterior fontanelle remains widely patent after its normal time of closure, and, since there is often delayed closure of the sutures also, the condition may be mistaken at first sight for hydrocephalus.

Craniotabes

In young infants, particularly prematures, who are subject to early and severe rickets, extreme thinning of the skull (craniotabes) may occur in the occipital or parietal region, on which the weight of the head rests. The soft bone becomes like parchment, and 'egg-shell crackling' is felt on slight pressure.

Spine The spine shares in the general osteoporosis, and infants who have begun to sit or walk are liable to develop scoliosis or kyphosis, accentuating the thoracic deformity and resulting in dwarfing. In most cases, however, it is muscular hypotonia rather than osteoporosis that causes rachitic kyphosis or scoliosis.

Limbs The bones of the extremities are nearly always affected to some extent in later infancy, since the weight of the body on the arms or legs results in curving of the softened long bones (see Fig. 77) or more rarely in spontaneous fractures. Genu valgum or varum and coxa vara occur in infants who have learnt to stand and in cases of late rickets. The epiphyses of the wrists and ankles are commonly enlarged, and a slightly fusiform swelling of the phalanges of the fingers may be observed in some severe cases (see Fig. 77).

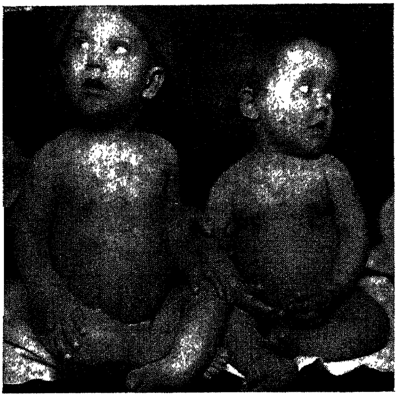


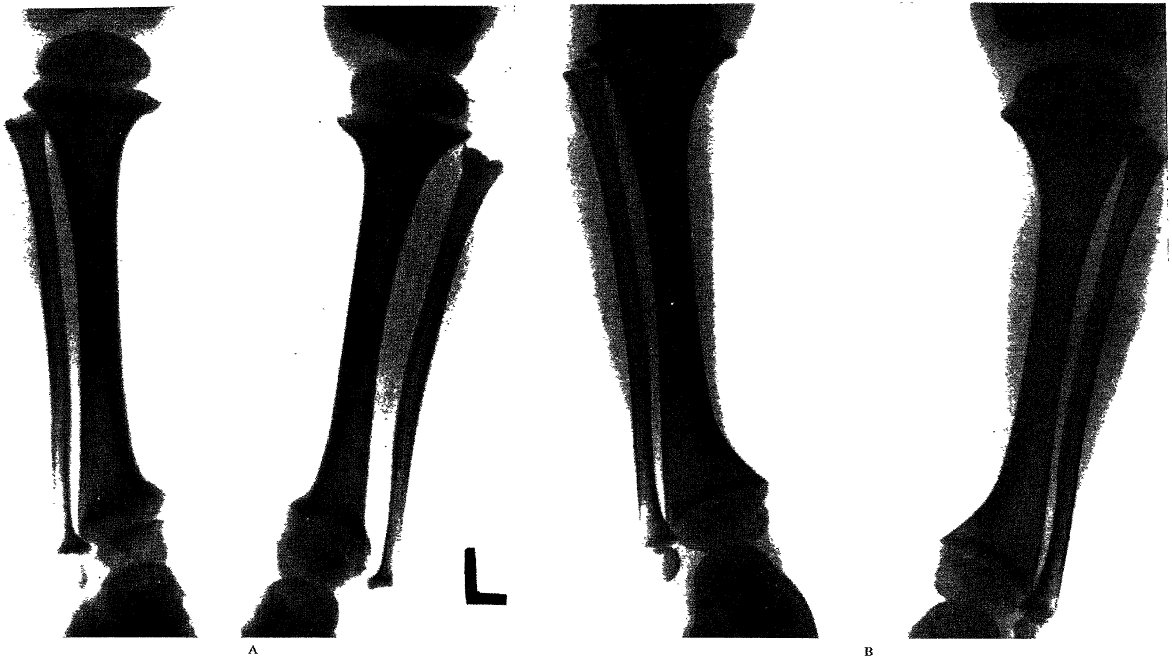
FIG. 77.—Rickets in twins aged 34 months. Boy on left shows enlargement of epiphyses, sausage-shaped fingers, and deformity of legs; girl shows Harrison's sulcus and frontal bossing. (By courtesy of Dr. F. J. Poynton)

Pelvis The pelvis is also liable to become flattened or triradiate, the latter deformity being seen particularly in osteomalacia. In women it may make normal delivery impossible.

Dentition Delayed dentition is almost constant in severe rickets and common in the milder forms. The relation of rickets to dental caries is much less definitely established; although rachitic children may show defective calcification of both the first and the permanent teeth, they do not necessarily do so (see Vol. III, Fig. 71, p. 606).

Muscular system and development The rachitic infant is typically fat and flabby. The muscles are hypotonic, and many infants come under observation in the first instance on account of failure to sit up, crawl, or walk at the proper time. In the second year of life rickets is probably the commonest cause of an infant 'going off its legs' after having previously been standing normally. Many infants show a curved kyphosis in the sitting posture from the same cause. The abdominal muscles are also lax, resulting in the characteristic 'pot-belly.' Sweating of the head is common but of little value in diagnosis.

Respiratory system The rachitic infant is conspicuously subject to infection, particularly of the respiratory tract. Repeated attacks of bronchitis are so common as to be almost symptomatic. Their occurrence will accentuate thoracic deformity, and during the course of acute bronchitis or broncho-



Radiographs of long bones of the legs in rickets. A. Active rickets, showing cupping and feathery line of ossification. B. Healed rickets; same case, three months later, after treatment with irradiated evaporated milk; note diminished cupping, regular line of ossification, and dense band of calcification at metaphysis

PLATE X

[*To face p.* 669

pneumonia it is often possible to see the Harrison's sulcus in process of formation, the depression appearing first only during inspiration and subsequently becoming permanent.

Nervous system

Tetany

Infantile tetany (spasmophilia) is closely associated with rickets but is only likely to occur in cases in which the serum calcium has fallen below 6 mgm. per 100 c.c. As with rickets, the highest incidence is in spring, following the darkest months of the year. The condition is characterized by general muscular irritability, convulsions, laryngismus stridulus, and carpopedal spasm (see Vol. III, p. 419). Head-rolling or nodding (spasmus nutans), with its peculiar type of nystagmus, may be seen. Both conditions are probably due to the affected infants being kept in dark rooms rather than to any direct relation between the two.

Head-rolling

Blood

Nutritional anaemia of microcytic hypochromic type is extremely common, particularly during the second year of life. Signs of rickets are also present in the majority of infants suffering from von Jaksch's anaemia (pseudoleukaemia infantum, see Vol. I, p. 464).

Gastro-intestinal system

The 'pot-belly' of rickets is due not only to laxity of the abdominal muscles but also to flatulent distension. The infant suffers from frequent gastro-intestinal upsets, and the stools, though not necessarily diarrhoeal, tend to become green and 'spinachy'. There is poor resistance to gastro-enteritis, but the marasmic infant is unlikely to manifest rickets owing to the associated lack of growth. The liver and spleen are frequently palpable, often due to their downward displacement by deformity of the thorax. When there is associated anaemia, both liver and spleen may be enlarged.

Liver and spleen

Radiological changes

Although the radiological evidence of slight and very early rickets is often disputable, some authors finding 'rachitic changes' in many clinically normal actively growing infants, the appearance of the established disease is characteristic. The changes are usually best seen at the wrists, ankles, and costochondral junctions. Instead of there being a sharply defined and regular line of ossification separating bone from cartilage, the end of the shaft is cupped and has a feathery irregular outline fading almost imperceptibly into the area of cartilage (see Plate X, A). If the bone is radiographed on the same plate as a normal control, the generalized osteoporosis is obvious, although the shaft may be somewhat thickened. With healing of the rachitic process the cupping becomes less prominent, but some deformity will remain. The line of ossification again becomes clearly defined, and there is a more densely calcified area at the metaphysis than in the normal (see Plate X, B).

5.–COURSE AND PROGNOSIS

The course in infantile rickets is extremely variable, depending on the circumstances of the child's life. By the age of two the great majority of infants have been sufficiently exposed to ultra-violet rays to cause healing of the rachitic process, although the diet is often still grossly inadequate, consisting largely of carbohydrate. In some cases, however, active rickets persists for four or five years, particularly in children of dark-skinned races living in northern climates. More rarely there appears to be a definite resistance to vitamin D, enormous doses being necessary before healing occurs. Under treatment there should be evidence of healing in three to six weeks, but the calcium balance improves even more rapidly.

Prognosis

The prognosis as regards life is good, unless the infant succumbs to secondary infection. Established deformities will persist unless treated, but with healing and bone growth they tend spontaneously to become less severe.

6.–DIAGNOSIS AND DIFFERENTIAL DIAGNOSIS

The diagnosis of rickets can be made on clinical, radiological, and biochemical investigation; although clinical examination alone will suffice in well established cases, the diagnosis of the earlier stages may require confirmation by X-rays. Estimations of serum calcium, inorganic phosphorus, and more particularly phosphatase (see p. 665) are most helpful as an index of activity or healing.

No single bony deformity is invariably present, but rachitic beading of the ribs, as distinct from scurvy beading (see p. 667), is probably the most useful single sign, and craniotabes in young infants and enlargement of the epiphyses are strongly suggestive. The diagnosis is therefore made on the association of several of the signs described on page 667, confirmed by the typical radiological changes and the presence of a high plasma-phosphatase, with usually a reduced blood-phosphorus and a serum calcium at the lower limits of the normal range (8 to 11 mgm. per 100 c.c.) or, more rarely, a serum calcium of less than 8 mgm. per 100 c.c. The value of the Ca × P product has been mentioned on page 665.

Diagnosis from osteogenesis imperfecta

Rickets must be distinguished from osteogenesis imperfecta in infants in whom multiple fractures of the ribs may simulate beading, or of the limbs rachitic deformities. The parchment-like condition of the skull which may be seen in osteogenesis imperfecta is not limited to the parietal and occipital regions as in craniotabes. A family history and the presence of blue sclerotics will indicate osteogenesis imperfecta, and in cases of doubt X-ray examination will make the distinction clear. (See also BONE DISEASES, Vol. II, p. 554.)

From achondroplasia

Achondroplasia will seldom cause confusion if the characteristic shortening of both arms and legs (which, however, may be bent), the facies, and trident hand be borne in mind. The X-ray appearances are also diagnostic. In older children chondro-osteo-dystrophy (Brailsford-Morquio type) may be mistaken for late rickets, but here again the X-ray appearances (wide intervertebral joint spaces, fragmentation of epiphyses, and deformity of bodies of lumbar vertebrae) differ from those of rickets. (See also Vol. I, p. 143, and Vol. IV, p. 285.)

From chondro-osteo-dystrophy

From syphilis

Infants affected with congenital syphilis often show stigmata of rickets also. Syphilis should be suspected if there is splenomegaly (a more constant finding than hepatomegaly), considerable hepatomegaly, a rash, or snuffles. Radiographs of the long bones frequently show the characteristic 'moth-eaten' areas of rarefaction at the ends of the long bones or periostitis along the shaft (see also Vol. II, p. 579, and Vol. V, p. 130). Scurvy is characterized by the haemorrhagic tendency and the severe pain, which is seldom a feature of rickets though it may occur with spontaneous fractures and is not uncommon in osteomalacia.

From scurvy

In all cases of late rickets the possible association with coeliac disease or renal disease should be investigated.

7.–TREATMENT

(1)—Preventive

There are two methods of prevention: regular exposure to ultra-violet rays from an early age and the addition of vitamin D to the diet. The regular exposure of a comparatively small portion of the body-surface, e.g. face, hands, and legs, to ultra-violet rays is disproportionately effective. If an infant is kept indoors even with the windows open, it will get practically no ultra-violet rays in the further parts of the room, and ordinary window-glass prevents the passage of any. Solaria made of vita-glass to be effective must allow the entrance of direct sunshine through a wide angle.

Ultra-violet rays

In northern climates it is advisable to add vitamin D to the diet of all infants between the ages of three months and two years. This may be given in the form of cod-liver oil, preferably as a standard 50 per cent emulsion, or in a more concentrated form as halibut-liver oil or calciferol. Two fluid drachms three times a day of 50 per cent cod-liver oil emulsion or six minims of halibut-liver oil, or concentrates containing calciferol should be given during the winter months to infants over six months old. The concentrates are preferable to cod-liver oil if there is any fat intolerance, e.g. in coeliac disease. Irradiation of food-stuffs has also been effective in preventing rickets, and irradiated milk, both fresh and evaporated, appears to have a somewhat higher antirachitic value for human infants than its unit-content of vitamin D might suggest. Experimentally it has been found that even irradiation of the cow, or feeding irradiated yeast to the cow, will increase the vitamin D content of the milk very considerably (Hess *et al.*, 1931).

Vitamin D

(2)—Specific

Specific therapy follows the same lines as the preventive. Exposure to ultra-violet rays can be effected during the winter months by means of the carbon-arc or the mercury-vapour lamp, the latter giving off a greater proportion of antirachitic rays.

Ultra-violet rays

In the treatment of active rickets larger doses of vitamin D concentrates can be given than for prevention. Daily doses of two to three thousand units of calciferol should be rapidly effective. Optimal results

Vitamin D

Calciferol

are likely to be obtained with a combination of graduated exposure to ultra-violet rays and vitamin D added to the diet. Experimentally, large amounts of irradiated evaporated milk have been found effective without other adjuvant treatment.

Hygiene In addition to the administration of the necessary vitamin D, it is essential to correct the child's hygienic surroundings, and the bony *Correction of bony deformities* deformities may require treatment. While the bones are still soft, the deformed limbs should be splinted, and thus a considerable degree of correction can be effected. In severe cases subsequent osteotomy may be necessary after the active rachitic condition has fully healed.

II.—RENAL RICKETS

1.—DEFINITION

1384.] This is a rare condition of defective calcification of the skeletal system associated with a chronic renal lesion and may become manifest in at least two forms. One type of renal rickets closely resembles infantile (vitamin D deficiency) rickets, whereas the other shows characteristic features probably more directly related to hyperplasia of the parathyroid glands.

2.—AETIOLOGY

The various hypotheses of pathogenesis that have been put forward attempt to relate the bone changes to (i) the renal lesion and (ii) disturbances of the endocrine system, particularly of the parathyroids. Other aetiological factors are of secondary importance.

Race Most cases have been described in the English literature, but this is probably due to the condition having first been recognized in England. An increasing number of reports now appear in European and American *Sex* literature. Both sexes are affected, but the condition has been described more frequently in boys than in girls.

Heredity The familial incidence of chronic nephritis is well recognized, and, since this applies to the disease in childhood as well as in adult life (Mitchell), it is not surprising that examples of familial renal rickets (Still) or the familial association of renal rickets and chronic nephritis have been recorded.

Age The commonest age of onset of gross rachitic deformities is between six and twelve years. As in coeliac disease, the arrest of growth and of development (renal infantilism and dwarfism), which is a common association, is apt to mask the earlier occurrence of active rickets. Examples, however, have been described in the first two years of life.

Diet and ultra-violet rays It is doubtful if either diet or ultra-violet radiation is of aetiological importance.

3.–PATHOGENESIS AND MORBID ANATOMY

This may be considered under four headings: renal lesion, bone changes, endocrine glands, and biochemical changes.

Renal lesion

Two requirements are necessary for the production of renal rickets: the renal lesion must be sufficiently severe to cause considerable impairment of function, and it must be of relatively long standing. The commonest finding in the kidney is nephrosclerosis (small red granular kidney), but multiple calculi and pyelonephritis have also been described. A. Ellis and H. Evans recently made the observation that, even when the kidneys show the appearance of chronic interstitial nephritis, there is commonly bilateral dilatation of the ureters, and suggested that chronic back-pressure due to dysfunction of the neuromuscular mechanism at the base of the bladder might play an important part in causation. It was later shown (R. W. B. Ellis) that this dilatation might be due to a valvular obstruction in the posterior urethra (see Fig. 78). The late appearance of hypertension also distinguishes most cases of chronic interstitial nephritis in childhood from the disease in adult life. It is possible that in some cases at least there is a congenital hypoplasia of the renal tissue, the dysfunction being made more severe by chronic back-pressure or by infection. Rarely the condition has followed an attack of acute nephritis.

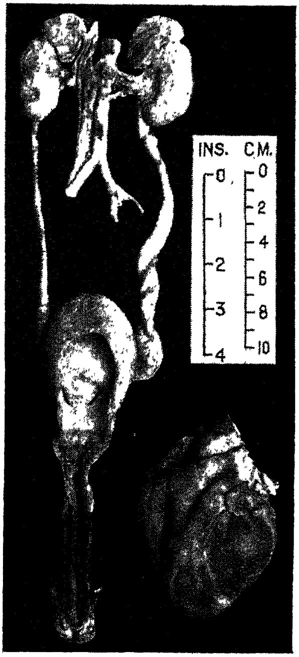


FIG. 78.—Renal rickets. Small granular kidneys with adrenals attached, dilated ureters, hypertrophied bladder, and posterior urethral valve (indicated by arrow) from patient shown in Fig. 79. (This and Fig. 79 from *Lancet*, 1935)

Cystinuria

Russell and Barrie and others described cases in which cystinuria and cystine deposits in the kidneys and spleen were found; these cases probably represent a distinct type of renal rickets in which the underlying cause is an abnormality of cystine metabolism.

Bone changes

The radiological studies of Parsons and of Teall have done much to clarify the nature of the bone changes. Parsons distinguished three types: an atrophic type, a type indistinguishable from infantile rickets, and a 'woolly' or 'stippled' type, the appearances of which are diagnostic. Teall subsequently regarded the first as simply an earlier stage of the second. Necropsies have confirmed the view that there are two types of lesion. Thus Turnbull found histological changes identical with those of infantile rickets, whereas Langmead and Orr and others have described in addition great osteoclastic activity, lacunar resorption of the bony lamellae, and fibrous marrow of the shafts of the long bones and skull. They drew particular attention to the similarity of these changes to those seen in osteitis fibrosa.

Endocrine glands

With the exception of Chown, who suggested that renal rickets and dwarfism should be regarded as a pituitary disease, most authors writing recently on the connexion between the endocrine glands and renal rickets have directed their attention to the parathyroids. No abnormalities of the thyroid, pancreas, or adrenals have been found, and such changes as have been observed in the thymus and gonads have not been regarded as primary.

Hyperparathyroidism

A generalized hyperplasia of the parathyroid glands has now been recorded in several cases. Price and Davie suggested that renal rickets represented the common ground of overlap of hyperparathyroidism and chronic renal damage. Primary hyperparathyroidism, with or without pituitary changes, will be suspected in the presence of hypercalcaemia, calcareous deposits in the kidneys, the 'woolly' type of radiological change, and hyperplasia of the parathyroids. Congenital abnormalities of the urinary tract or a history of acute nephritis will point to a primarily renal origin. There is, however, experimental evidence that destruction of renal tissue causes parathyroid hypertrophy (Pappenheimer), so that possibly in different cases either a primary renal or parathyroid abnormality may result in a similar clinical picture.

Biochemical changes

The condition is constantly associated with impairment of renal function and a high blood-urea, which may be over 100 mgm. per 100 c.c. for several years. The retention of phosphate due to impairment of renal excretion, which was observed in many cases, was thought to be responsible for the defective calcification of the skeleton, but it was subsequently shown that renal rickets might occur without phosphorus retention. Mitchell suggested the alternative hypothesis that the phosphorus which could not be excreted by the damaged kidney was re-excreted into the intestines, where it formed insoluble calcium phosphate with the calcium present in the diet. A true calcium deficiency therefore resulted. On the other hand, hypercalcaemia, as described by Price and Davie, suggests mobilization of calcium from the skeleton by parathyroid over-activity, with resultant calcareous foci in the kidneys. It has been suggested that these foci may cause renal sclerosis, and a similar explanation may apply to those cases characterized by abnormal cystine metabolism. The blood phosphatase is commonly raised, and the blood cholesterol may also be slightly increased. There is frequently an associated acidosis.

4.–CLINICAL PICTURE

Patients usually come under observation on account of either the urinary symptoms, small stature, or bony deformities (see also Vol. IV, p. 297).

Urinary symptoms

When the renal lesion is nephrosclerosis, polyuria and polydipsia are likely to be extreme. A child who has previously been clean develops constant frequency and nocturnal and diurnal enuresis, the volume of urine passed being likely to excite comment. If there is chronic infection or obstruction, there may be a history of fever, dysuria, or dribbling incontinence. Coincidentally with the urinary symptoms, excessive fluid intake and thirst are noticed. The mother of a boy of four explained that when she tried to limit his fluids, the child would drink water from the flower vases, vinegar from the pickle jar, or even his own urine. The urine is pale and of low specific gravity, showing a trace of albumin and occasional casts. More rarely it contains pus cells and *Bact. coli*, sugar, or cystine crystals.

Infantilism

Infantilism is an extremely common association with renal rickets, growth having stopped suddenly with the onset of the urinary symptoms, usually some considerable time before the bony deformities occurred. The child retains the proportions of the age at which growth ceased; in older children sexual development fails, and the secondary sexual characters are absent.

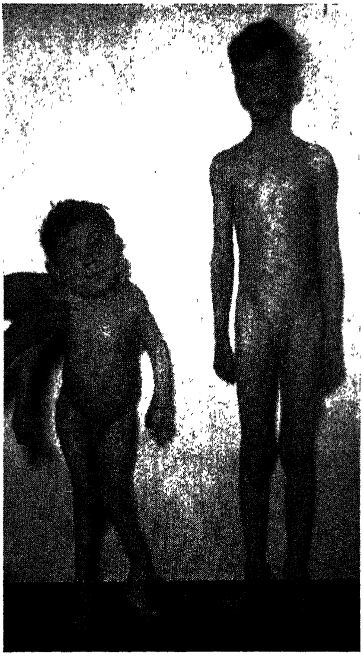


FIG. 79.—Renal rickets in boy aged 9 years 10 months (same case as in Fig. 78) showing dwarfing and deformities, with normal control. (By courtesy of Dr. E. A. Cockayne and of the *Lancet*)

Bony changes

Bony changes commonly occur rapidly, causing the most bizarre deformities, increasing the dwarfism, and greatly limiting activity (see Fig. 79). The earliest and most severe changes are commonly in the long bones, in the region of the epiphyses, and both the skull and ribs are liable to be affected. Genu valgum is particularly frequent, and acute bending of the tibiae immediately above the ankles is often seen. Indeed any of the bony changes characteristic of severe infantile rickets may occur, but the anterior fontanelle will have closed in any except the earliest cases. Occasionally fractures occur spontaneously or after slight trauma.

Pigmentation

Although some of the affected patients are of good colour and at first glance appear to be normal children of younger age, most show a slightly muddy discoloration of the skin. It has been stated that this discoloration does not affect the sclerae, but I have observed two cases in which this was obvious. The pigmentation becomes more obvious in the presence of secondary anaemia.

Terminal symptoms

In uncomplicated cases the disease is prone to terminate in uraemia, with muscular twitching, convulsions, vomiting, dyspnoea, and drowsiness preceding death. The blood-pressure and the blood urea are raised and there is a variable degree of oedema. Temporary recovery from uraemia, however, may occur and death be delayed for a year or more.

5.–COURSE AND PROGNOSIS

The disease is invariably fatal, and it is doubtful if any treatment influences the ultimate prognosis, which depends not on the rickets but on the associated renal lesion. Unlike chronic nephritis in adults, however, the disease in children often runs a course of several years after symptoms have appeared. Thus the case illustrated was known to have a blood urea of over 90 mgm. per 100 c.c. for more than five years. The blood-pressure is seldom raised until the terminal stages of the disease (see p. 673).

6.–DIAGNOSIS AND DIFFERENTIAL DIAGNOSIS

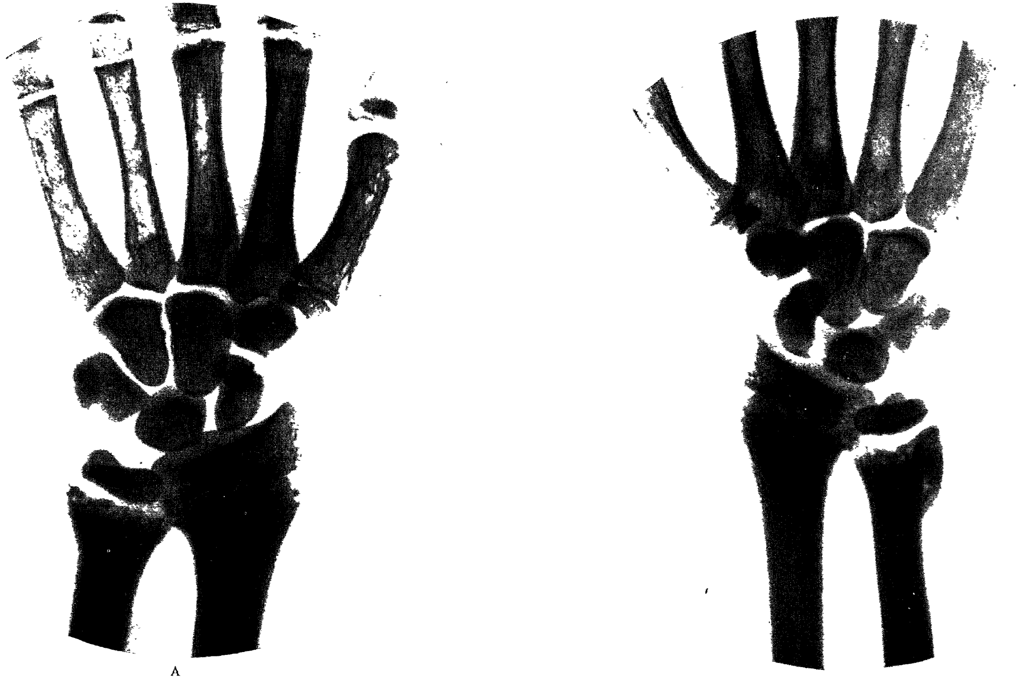
Renal rickets should always be suspected in a patient in whom bony deformities, particularly genu valgum, appear in later childhood or when there has been no evidence of vitamin D deficiency. The diagnosis is confirmed by the delay in growth, the urinary symptoms and findings (see p. 675), the raised blood urea, and the greatly impaired renal function.

X-rays

Radiological examination shows either generalized osteoporosis, or the changes seen in infantile rickets, or the pathognomonic 'woolly' and 'stippled' changes seen in the skull or in the metaphyses of the long bones. Teall described the metaphyses as appearing eaten away under the periosteum and resembling a wooden post which had rotted under the earth. Collapse and deformity of the eroded metaphysis will result in lateral displacement of the epiphysis. (See Plate XI.)

Diagnosis rom oeliac ickets

Coeliac rickets will be distinguished by the large abdomen, the characteristic history of diarrhoea, and the presence of fat in the stools.


A
B

Radiographs of wrists (A, right; B, left) in 'woolly' type of renal rickets. Note subperiosteal erosion and asymmetry of lesions. (By courtesy of Dr. C. G. Teall)

PLATE XI

7.–TREATMENT

Calcium therapy

Ultra-violet rays

On the supposition that renal rickets was in some cases due to calcium deprivation Salvesen tried the effect of large doses of calcium lactate with and without cod-liver oil. In both experiments he found that this treatment caused a temporary disappearance of uraemic symptoms, a fall in blood urea and blood phosphorus, a rise in serum calcium, and the disappearance of acidosis. The ultimate prognosis, however, was unaffected. Numerous authors, including Salvesen, have found that ultra-violet irradiation is liable to increase or precipitate uraemic symptoms. The same danger applies to operative interference with bony deformities, the underlying condition having been recognized in some earlier cases only when operation had resulted in uraemia and death.

Vitamins A and D

With alkalis

With regard to the use of vitamin D preparations alone, most authors regard the practice as useless or dangerous. Graham and Oakley, however, recently reported considerable improvement in both the rachitic condition and growth of two patients treated with vitamins A and D, together with sufficient alkalis to restore the depleted alkali reserve to normal. The negative phosphorus-balance was readjusted by this treatment, and the calcium retention greatly improved. Since the vitamins A and D and alkalis (magnesium oxide and sodium bicarbonate) were given together, it is not possible to say from these observations which was primarily responsible for the improvement. The experience of other authors suggests that the correction of the acidosis was the essential factor.

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RICKETTSIA INFECTION

See TRENCH FEVER; *and* TYPHUS FEVERS

RIEDEL'S IRON-HARD STRUMA

See GOITRE AND OTHER DISEASES OF THE THYROID GLAND, Vol. V, p. 624

RIFT VALLEY FEVER

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1.–DEFINITION

1385.] Rift Valley fever or enzootic hepatitis is an acute virus infection producing liver necrosis in sheep and cattle in certain parts of tropical Africa and readily transmissible to man, in whom it causes a febrile reaction, often tending to relapse, associated with prostration, headache, and muscular pains.

2.–AETIOLOGY

Geographical incidence

The disease was first described by Daubney, Hudson, and Garnham in 1931 in Kenya, British East Africa, where, on the shores of lake Naivasha, it caused a severe epizootic entailing the death of thousands of lambs and sheep. In all probability the condition was observed in the same area by Montgomery in 1912. Since the first recognized outbreak in 1931, others have been recorded in Kenya among both sheep and cattle. Evidence from immunity reactions indicates that Rift Valley fever has also occurred in recent years in Uganda, the Nuba Mountains area of the Southern Anglo-Egyptian Sudan, French Sudan, and possibly in parts of French Equatorial Africa. There is no evidence that it has occurred in West Africa (Findlay, Stefanopoulo, and MacCallum, 1936).

Causal organism

The disease was shown to be due to a filterable virus and to be highly infective for man, those in charge of herds being specially liable to infection; a number of laboratory workers have also contracted the disease.

Characteristics of the virus

The virus of Rift Valley fever has been shown by differential filtration to be approximately 23 to 35mμ in size (Broom and Findlay, 1933). It is comparatively resistant to phenol and may be preserved for months in 50 per cent glycerin in physiological saline or after freezing and drying *in vacuo*. *Cultivation* The virus has been cultivated in serum-Tyrode fluid containing chick embryo tissues, and on the chorio-allantoic membrane of the developing chick embryo (Mackenzie, 1933; Saddington, 1934). *Vector* Infection is not transmitted by contact, and some arthropod host almost certainly acts as a vector.

Susceptible animals Rift Valley fever is transmissible by injection to several animal species, including many species of monkey, the goat, red squirrel, rat, mouse, and field vole (Findlay, 1932). A number of wild African rodents, such as *Arvicanthis abyssinicus nairobiae*, *Mastomys coucha panya* and *Rhabdomys pumilio* (Daubney and Hudson, 1933), can also be infected, but the rabbit and guinea-pig are insusceptible. The goat shows merely a short non-fatal febrile reaction, as do the Indian rhesus monkey and certain species of South American monkey: African monkeys, however, show no rise in temperature, but the virus circulates in the blood-stream, and immune bodies subsequently develop. Subcutaneous or intraperitoneal inoculation of the virus into mice causes death in 48 to 72 hours.

3.–MORBID ANATOMY

Liver in lambs and mice The chief morbid change is wide-spread necrosis of the liver parenchyma, especially well seen in lambs and mice, in which the normal structure of the liver lobules is completely disorganized: the liver-cells are rounded and separated from one another, and their cytoplasm stains intensely with acid dyes. *Inclusion bodies* The nuclei show margination of the chromatin and, before complete disorganization has occurred, may contain acidophil intranuclear inclusions very similar to those seen in the liver in yellow fever. *In other animals* In the adult sheep, goat, rat, and monkey the liver necrosis is focal instead of diffuse, and in the cytoplasm of some of the liver-cells at the periphery of the necrotic areas are round hyaline bodies, separated from the remainder of the cytoplasm by a clear space and resembling the structures described in the human liver in yellow fever and known as Councilman lesions. *Councilman lesions*

Changes in other organs In sheep and mice there are also enlargement and sometimes haemorrhage in the mesenteric lymph nodes, haemorrhages in the gastric mucosa, and cloudy swelling and necrosis of the tubular epithelium of the kidney.

In man Since no fatal case has occurred in man during the acute stage of the disease, the morbid lesions are unknown, although in all probability they resemble those in the rhesus monkey.

4.–CLINICAL PICTURE

In sheep and cattle In sheep and cattle, after an incubation period of 2 to 3 days, the temperature rises, with symptoms of extreme prostration. Death may follow in a few hours. In pregnant animals abortion is common.

In man: onset

In man, after an incubation period of 3 to 4 days, symptoms begin with severe headache, chiefly frontal and post-orbital, pain in the back, and aching in the long bones and muscles. The conjunctivae are congested, and photophobia is common; the fauces are reddened. Bleeding at the nose is frequent at the beginning of the illness. The appetite is poor, and nausea may be present, but vomiting is rare.

Temperature

The temperature is usually between 103° and 105° F. and remains at this level, without any great daily variation, for two or three days, when it falls rapidly to 98° or 99° F. A further rise of temperature to 101° or 102° F. may occur after an interval of about twenty-four hours; at the same time the general symptoms show an exacerbation. The second febrile attack lasts a shorter time than the first and in rare cases is followed by a still shorter third and even fourth pyrexial period; each febrile relapse is accompanied by a return of the general symptoms, which, however, are less severe with each relapse.

Other signs

The liver and spleen are not enlarged. The urine is highly coloured but does not, as a rule, contain either albumin or bile. The pulse-rate corresponds to the temperature for the first two or three days but later becomes slow.

Blood picture

The red-cell count is unchanged; the white cells show an increase during the first twenty-four hours followed by a leucopenia and a relative increase in lymphocytes.

Convalescence

One fatal case

After the final fall in temperature complete convalescence is rapid. In the only fatal human case recorded (Schwentker and Rivers, 1934) a tendency to thrombosis occurred during convalescence, and the patient died from pulmonary embolism on the forty-fifth day after the onset of the illness.

5.–DIAGNOSIS AND DIFFERENTIAL DIAGNOSIS

Clinically the diagnosis of Rift Valley fever in man is by no means easy. A febrile reaction in man in association with a febrile disease of sheep or cattle should raise a suspicion of Rift Valley fever.

Injection of mice

Complement-fixation test

Test for immune bodies in blood

Since virus is present in the peripheral blood during the whole of the febrile period, a rapid diagnosis may be made by injecting blood into mice. After an intraperitoneal injection of 0·1 c.c. of blood mice die in 48 to 72 hours with the characteristic necrosis of the liver; since 0·1 c.c. of blood diluted 10^{-12} is fatal to a mouse, the test is very sensitive. After recovery Rift Valley fever may be diagnosed by the complement-fixation test (Broom and Findlay, 1932) or by demonstrating the presence of virucidal immune bodies in the serum. Such immune bodies are present in the serum certainly eight years after an attack (Findlay, 1936). A mixture of 0·4 c.c. of the serum to be tested and 0·2 c.c. of a 10^{-3} dilution of infected mouse liver is injected intraperitoneally into mice. If the serum does not contain immune bodies, the mice die with the characteristic liver lesions; if the serum contains immune bodies, the mice survive.

Differential diagnosis

Rift Valley fever must be differentiated from influenza, dengue, sand-fly fever, yellow fever, malaria, and relapsing fever. In influenza naso-pharyngeal catarrh is more pronounced; in dengue a characteristic rash appears about the fourth day, and the pains in the joints are usually more severe and more prolonged. In sand-fly fever the clinical symptoms are practically identical, but there is rarely a relapse once the temperature has fallen. Mild cases of yellow fever may be impossible to differentiate except by the result of injection of the blood into monkeys and mice. In malaria and relapsing fever the parasites should be found in the blood. Rift Valley fever is distinguishable from mild cases of leptospirosis (spirochaetosis) icterohaemorrhagica by the absence of jaundice, the leucopenia, the failure to isolate leptospira either from the blood during the febrile period or later from the urine, and the absence of agglutinins for leptospira (see also Vol. VII, p. 267).

6.—TREATMENT

Preventive: immune serum

The injection of immune serum induces a temporary passive immunity, which is not, however, of long duration. A modified neurotropic strain of Rift Valley fever virus has been produced by repeated intracerebral passage in mice which had previously received an intraperitoneal injection of immune serum (Mackenzie and Findlay, 1936). This neurotropic strain, which has much in common with the neurotropic strain of yellow fever virus, does not produce necrosis of the liver in mice, but injected intracerebrally it causes a fatal encephalitis. Intracerebral injection of monkeys and lambs also causes encephalitis, but subcutaneous injection does not cause any reaction, although it produces immunity against the ordinary pantropic strain (Mackenzie, Findlay, and Stern, 1936). This method of immunization is now (1938) being tested in sheep in East Africa.

In common with other virus infections the injection of immune serum has no therapeutic value once symptoms have developed, nor has any specific chemotherapeutic agent yet been found. Sulphanilamide and allied compounds are valueless.

Symptomatic treatment

Treatment is therefore entirely symptomatic. In view of the action of the virus on the liver, glucose or cane sugar by mouth is indicated; otherwise the diet should be restricted till the temperature falls, but as much fluid as possible should be taken. The headache may be relieved by phenacetin or by ice-packs to the head. During convalescence the possibility of thrombosis should be kept in mind.

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RINGWORM

See FUNGOUS DISEASES, Vol. V, p. 450

ROBERT PELVIS

See LABOUR, Vol. VII, p. 496

ROENTGENOLOGY

See RADIOLOGY IN DIAGNOSIS AND TREATMENT, p. 456

ROSACEA

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4. CLINICAL PICTURE AND PROGNOSIS - - 685
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6. TREATMENT - - - - - - 687

Reference may also be made to the following titles:

ACNE
LUPUS ERYTHEMATOSUS
LUPUS VULGARIS

1.–DEFINITION

1386.] Rosacea is a common disease of middle age characterized by persistent redness of the central parts of the face with secondary hypertrophy of the sebaceous glands and the formation of red papules and pustules.

2.–AETIOLOGY

Age and sex incidence

The disease is commonest in women about the time of the menopause, though it may occur at any age after thirty and even, rarely, as early as twenty-five. It is also common in middle-aged men.

Causes

The cause appears to be some form of dyspepsia leading to reflex flushing of the face. Formerly it was thought that the associated dyspepsia was usually hypochlorhydric. The latest figures, however, do not bear this out (Brown; Eastwood); only about half the patients have any degree of hypochlorhydria. The usual cause of the dyspepsia seems to be tea, though in some cases it is alcohol; failure to chew properly and hurrying over meals also play a part. Other causes of rosacea, or at least aggravating factors, are infections in the nose or sinuses and scurfiness of the scalp. Habitual exposure to cold aggravates the disease, and emotion may make it temporarily worse.

3.–MORBID ANATOMY

At first the flushing is temporary and occurs only after meals or hot drinks or in hot rooms. Later it becomes permanent; then the chronic congestion leads to hypertrophy of the sebaceous glands, and staphylococcal papules and pustules often appear.

New and dilated capillaries occupy the upper third of the corium, and there are areas of infiltration with small round cells and later with epithelioid cells; giant cells may be present. These nodules of infiltration occasionally form semi-translucent brown nodules almost like the apple-jelly nodules of lupus vulgaris; ordinarily they break down into pus, and many collections of polymorphonuclears are then found in the corium in all stages of degeneration. Scarring follows. There is hypertrophy of the sebaceous glands which, especially in males, may become so pronounced on the nose that it leads to great hypertrophy and deformity of that organ (rhinophyma).

Rhinophyma

4.–CLINICAL PICTURE AND PROGNOSIS

Signs and symptoms

The redness is usually most marked on the central forehead, nose, flush patches of the cheeks, and central chin. It is generally worse after meals or hot drinks and in hot rooms. The affected skin usually looks rather greasy, and the scalp is often scurfy or oily. Seborrhoeic eruptions, blepharitis, conjunctivitis, keratitis, and even corneal ulcer are not uncommonly associated with rosacea. On the red skin of the affected areas there are commonly red papules and often pustules, but there are no black-heads unless the patient has a persistent old acne vulgaris as well. Rarely, instead of papules and pustules, brown semi-translucent nodules, like lupus vulgaris nodules, are scattered about the nose, cheeks, and chin. Dilated venules can often be seen on the nose and cheeks.

The patient complains of a feeling of heat and burning of the face and is often much upset by the supposed implications of the red nose. Such patients seldom admit to having indigestion, meaning pain, but they often have flatulence, constipation, or a furred tongue.

Prognosis

In the absence of treatment the disease tends to persist, but the great majority of cases can be either cured or very greatly improved by suitable treatment.

5.–DIAGNOSIS

Diagnosis from acne vulgaris

Acne vulgaris is a disease of younger persons, generally under thirty. Black-heads are an essential feature of acne but are absent in rosacea. There is no flushing after meals in acne vulgaris. Acne vulgaris tends to affect the sides of the face, rosacea the central parts. About the age of thirty the two diseases may occasionally overlap.

From lupus erythematosus

In lupus erythematosus the red patches are generally sharply circumscribed, not diffuse as in rosacea, and the affected skin looks dry and scaly rather than greasy and hypertrophic. Lupus erythematosus may be unilateral, whereas rosacea is almost invariably bilateral and symmetrical. Papules and pustules do not occur in lupus erythematosus but are common in rosacea. An area of stippling due to filling of the orifices of sebaceous and sweat glands with horny plugs is strongly in favour of lupus erythematosus, as also would be central atrophic scarring in the patches. Lupus erythematosus is aggravated chiefly by sunshine, and rosacea by hot rooms or meals. But the diagnosis between early erythematous lupus erythematosus and rosacea may be very difficult.

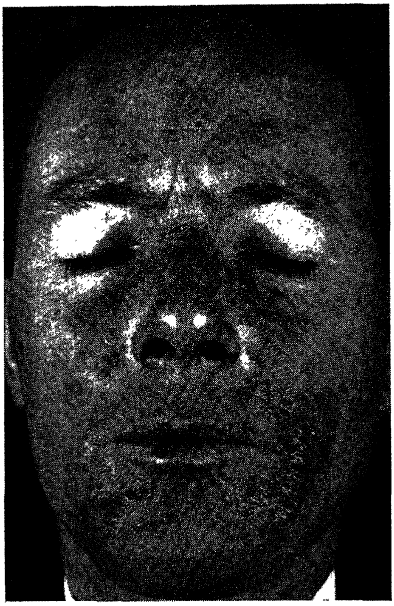

FIG. 80.—Rosacea

From recurrent cellulitis

Recurrent cellulitis is comparatively rare and usually affects one cheek much more than the other. It comes on in definite attacks, which are often precipitated by exposure to a cold wind and generally leave some permanent thickening. There are no papules or pustules.

From lupus vulgaris

In the rare cases of rosacea in which brown semi-translucent nodules are found lupus vulgaris must be excluded. This is usually possible from the shortness of the history, the fact that the nodules appeared all over the face about the same time, and the ready response to treatment.

If a case of apparent rosacea does not respond to the treatment outlined below the possibility of its being one of rosaceous tuberculide must be considered. The usual sites for this are the sides of the cheeks, the forehead, and the chin and neck; the centre of the face is rarely affected. There is no excess of sebum. The lesions are minute papules or very small, sometimes follicular, pustules. Large pustules such as sometimes occur in ordinary rosacea are absent. The colour of the papules is bright red to brownish-yellow. Glass pressure usually reveals a small brown or yellowish nodule at the site of the papule. The histology of the papules is typically 'tuberculous'. The intracutaneous tuberculin test is usually strongly positive and the response to intravenous injections of gold salts is often good. *From rosaceous tuberculide*

6.–TREATMENT

General Any focus of sepsis in the upper air-passages or in the teeth must be discovered and removed. The patient must have a sufficiency of opposing teeth to make mastication satisfactory. She must be persuaded to eat her meals slowly and to sit quietly for a time before and after each meal. Tea must be absolutely forbidden, though coffee may be allowed if it is not drunk too hot. Alcohol must not be taken. No drinks should be taken with meals, the necessary liquid being swallowed between meals. The patient must also avoid peppery and spicy foods, obviously indigestible articles of food, such as hot buttered toast, and anything else which has been found to disagree. Constipation if present should be treated. Anything which tends to flush the face, such as sitting in hot rooms or in front of a fire, washing with hot or very cold water, and in some cases the use of soap, must be avoided, because the aim is to get the skin capillaries out of the habit of being dilated.

Medicinal treatment I usually begin treatment with an alkaline gentian and rhubarb mixture thrice daily half an hour before meals. After two or three weeks a change to an acid mixture may be tried, e.g. dilute hydrochloric acid 30 minims, increased gradually to 60 minims, in water with or after meals. This has a dramatic effect in many cases, but, as it occasionally aggravates the disease, it is better to use the alkali first. If the acid causes 'heartburn' or makes the face worse, it is necessary to revert to the alkaline mixture before meals and to continue with it.

Local treatment The scalp, if scurfy, must be treated daily with a preparation of sulphur and/or salicylic acid, with a weekly shampoo. This is very important. The applications suitable for the face range from a plain calamine or calamine and lead subacetate lotion, through calamine and sulphur lotion, lotions of zinc sulphate and sulphurated potash (see Vol. I, p. 161), to pastes containing resorcinol and sulphur 2 per cent or more of each in zinc paste. My practice is to start with the plain calamine lotion and to work up gradually through the stronger applications as far as required. Often a stronger preparation can be applied at night and a plain calamine lotion in the day-time. Lead subacetate and sulphur must not be used in the same lotion or be allowed to meet on the patient's face, otherwise black lead sulphide will be deposited in the opening of each sebaceous gland.

Electrolysis and irradiation

Dilated venules can be obliterated by electrolysis or by the galvano-cautery. X-rays in small weekly or fortnightly doses are sometimes extremely successful, though occasionally they aggravate the disease. They are also very useful in treating the accompanying blepharitis. Ultra-violet rays generally make rosacea worse.

The treatment of rhinophyma is surgical and consists in paring away the hypertrophic skin and sebaceous glands under a local anaesthetic until the nose is restored to a normal contour. Care must be taken not to penetrate the skin and damage the cartilages. Bleeding is free but is controlled by pressure. The epidermis is very rapidly restored from islets remaining in the crypts and follicles. The colour of the nose soon after healing may be rather mottled, red and yellow, but after a few months it returns practically to normal.

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See MOUTH DISEASES, Vol. VIII, p. 645;
and PAROTID GLAND DISEASES, Vol. IX, p. 449

SALPINGITIS

See FALLOPIAN TUBES DISEASES, Vol. V, p. 251

SANATORIUM TREATMENT

See LUNG DISEASES: TUBERCULOSIS, Vol. VIII, p. 198

SAND-FLY FEVER

See PHLEBOTOMUS FEVER, Vol. IX, p. 583

END OF VOL. X

NOTE

An exhaustive analytical index to the *British Encyclopaedia of Medical Practice* will be published on completion of the work. In the meantime, each individual title is separately indexed in the volume to which it belongs, and there are additional references and cross-references to assist the reader in finding whatever information he may require as easily and quickly as possible.

The entries in heavy type (e.g. **Poisons Legislation: Medical Aspects**) indicate the individual titles; those in large capitals (e.g. ACHLORHYDRIA) indicate the additional references and cross-references.

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